THE FOUNDRY

VOL. 10. DETROIT, MICH., MAY, 1897. No. 57

THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

Will Meet in Convention in Detroit, May 10th, 11th, 12th and 13th All the Arrangements for a Most Successful Meeting Perfected.

Reduced Rates, With Tickets Good for Ten Days, on All Railroads East of the Rocky Mountains.

NUMEROUS SUBJECTS OF VITAL INTEREST TO THE BUSINESS TO BE DISCUSSED.

Some Valuable Papers Will be Read by Well-Known Foundrymen An Exhibit of Foundry Appliances Among the Novel Features.

It would not be news to state that the American Foundrymen's Association will hold their 1897 convention in Detroit during the second week of May, but it may be now a matter of news to advise the foundrymen of America and their friends that all the arrangements for the meeting are completed.

THE ASSOCIATION'S GROWTH.

Since the organization of the association in May, 1896, it has had a really wonderful growth, and, notwithstanding the frightful condition of business in this country it has managed to increase until over 500 names have been enrolled and its members are to be found in every state in the nation.

The executive committee came to the conclusion soon after the organization was completed that it would be better to devote the first year to the upbuilding of the association, as until a certain membership was attained, it was not considered desirable to commence any aggressive work.

ITS POSSIBLE FUTURE.

If the success of the past without any great incentive to join judged from a strictly materialistic point of view is any good criterion, it would seem to THE FOUNDRY that it is difficult to tell what measure of success may not be in store for the Association when it gets right down to business, commences to carry out some of the reforms, and inaugurate the progressive policy now being discussed so generally among the members who have given the matter the most attention.

PRESIDENT FRANCIS SCHUMANN'S CALL.

This Convention has been called, therefore, in order that the members of the Association may get together and consider these matters and any others that may be offered for consideration.

The call for the meeting issued by President Francis Schumann of Philadelphia reads as follows:

"In harmony with a resolution that has received the sanction of the Executive Board, it gives me much pleasure to issue this call for the 1897 meeting of the American Foundrymen's Association.

The foundrymen of the city of Detroit having very kindly sent this Association a courteous invitation to hold our next session in that city and said invitation having been accepted, I have set Monday, May 10, at 2 p. m. as the time for the calling to order of this, our first Convention.

During the past year the work of organization has been carried on very successfully in the face of many discouragements, not the least being the unsatisfactory business situation.

It is very gratifying, however, to be able to state that our prospects for the future are of the brightest description, and I feel sure that the coming meeting will perfect such legislation and outline such a plan of action as will make it imperative for almost every foundryman to affiliate with us.

To aid in the attainment of such a much-to-be-desired-end and for the purpose of adopting measures that may further popularize our society and benefit its members, this meeting is called.

Various papers on different topical subjects will be submitted for the consideration of those present, and all will be cheerfully invited to take part in any discussions that these papers may suggest.

Every man interested in the foundry business, either as a proprietor, stockholder, superintendent, foreman or chemist, and all those whose occupation brings them closely into contact with it, as manufacturers of, or dealers in foundry supplies and equipments or material are most sincerely urged to be present, whether members or not.

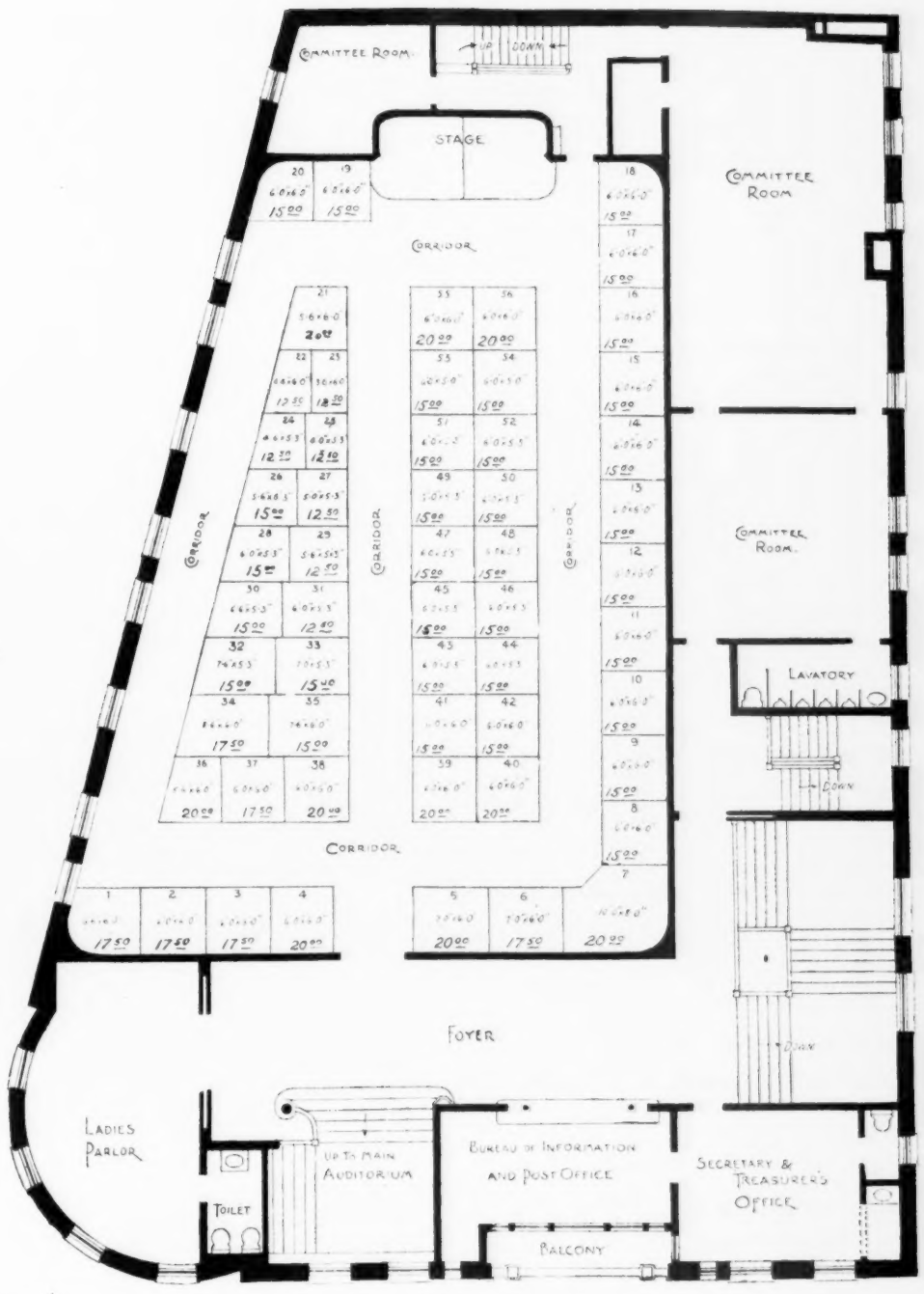
You are, therefore, cordially invited to meet with us, partake of the hospitality of Detroit's foundrymen and aid in every way possible, both by voice and influence, in improving the conditions that at present seriously handicap our business.

(Signed) Francis Schumann, Pres.

HARMONIE HALL—CONVENTION HEADQUARTERS.

WHY HELD IN DETROIT.

Many months ago a number of Detroit foundrymen extended an invitation to the American Foundrymen's Association to hold their next meeting in Detroit.



FLOOR PLAN OF EXHIBIT HALL AT CONVENTION OF AMERICAN FOUNDRYMEN'S ASSOCIATION HARMONIE HALL, DETROIT, MICH., MAY 10-13, 1897.

This invitation was referred to the Executive Board of the Association, acted on favorably, and the Detroit Committee notified to that effect.

As a result of the acceptance of the invitation there devolved upon the Detroit foundrymen a great responsibility.

ARRANGEMENTS COMPLETED.

It became their duty to make the gathering from a local standpoint as pleasant and agreeable as possible. It is true that the precedent set by the foundrymen of Philadelphia in the matter of entertainment was a difficult one to equal, but the local Committee have applied themselves with a degree of enthusiasm to the work that has been really surprising and it would seem as if everything had been arranged for except the weather.

REDUCED RATES ON RAILROADS.

In the first place, reduced rates of fare have been secured over nearly all the great railway systems of the entire country.

This is of itself a most valuable concession, as our friends everywhere can feel sure that it would not have been granted had we not been able to present indisputable evidence that we were certain of a very large attendance.

TICKETS GOOD FOR TEN DAYS.

A ticket that will be practically good for ten days, counting from the date of its purchase, can be secured, provided it is bought not later than May 7, and they will not be sold before.

HOW REDUCED RATES ARE SECURED.

It is necessary that the purchaser of the ticket should secure a certificate from the ticket agent at starting point, certifying that ticket had been secured from there to the Convention at Detroit. In case the ticket agent at starting point is unable to furnish certificates they can be obtained at the nearest station or ticket office of any size, or of

RUSSELL HOUSE—HOTEL HEADQUARTERS.

any ticket agent if given a few hours notice.

The certificate must be handed to the Secretary of the Convention within three days from the time the meeting is called to order, and after being signed by him and stamped and signed by the joint agent of the railroads located at that point it will entitle the owner to a return trip at one-third the regular fare, thus making the net cost of round trip ticket one fare and a third.

RUSSELL HOUSE—LOBBY.

HOTEL HEADQUARTERS.

Upon arrival in this city there are several hotels, all of them nicely situated, from which a selection can be made by those attending the meeting.

Detroit has long boasted of excellent hotels, and in this respect it is not second to any city of its size in America.

The Russell House, situated on Woodward avenue directly across the street from the City Hall, in the very business center of the city, only a few blocks from the Detroit river and its myriads of pleasure boats, has been selected as the hotel quarters, and here all are requested to register as near as possible after reaching the city.

Here will be found the gentlemen who constitute the local Reception Committee and the officers of the American Foundrymen's Association. Here also there will be established in the gentlemen's parlor on the second floor a Bureau of Information, where those who wish it will be given all the assistance possible concerning the city or anything connected with it.

THE BADGE.

The beautiful gold-plated souvenir badge that will be given to those attending the Convention will entitle the wearer to admission at all the business sessions as well as the various entertainments provided by the Reception Committee.

Each badge will have a separate number and a daily bulletin will be issued in which the name, address and business connection of each delegate will be printed.

CONVENTION HEADQUARTERS.

Convention Headquarters have been established at the Harmonie Hall, one of the most centrally located and convenient buildings in the city for such a purpose.

It is the home of the Harmonie Society, is beautifully furnished throughout, and those attending the Convention are invited to use its privileges subject to the rules of the House Committee.

Mail can be addressed here and will be cared for and delivered. If sent in the care of the Chairman or Secretary of the Local Committee it will receive prompt attention.

Here all the business sessions of the Convention will be convened, here also the various papers will be read and discussions held.

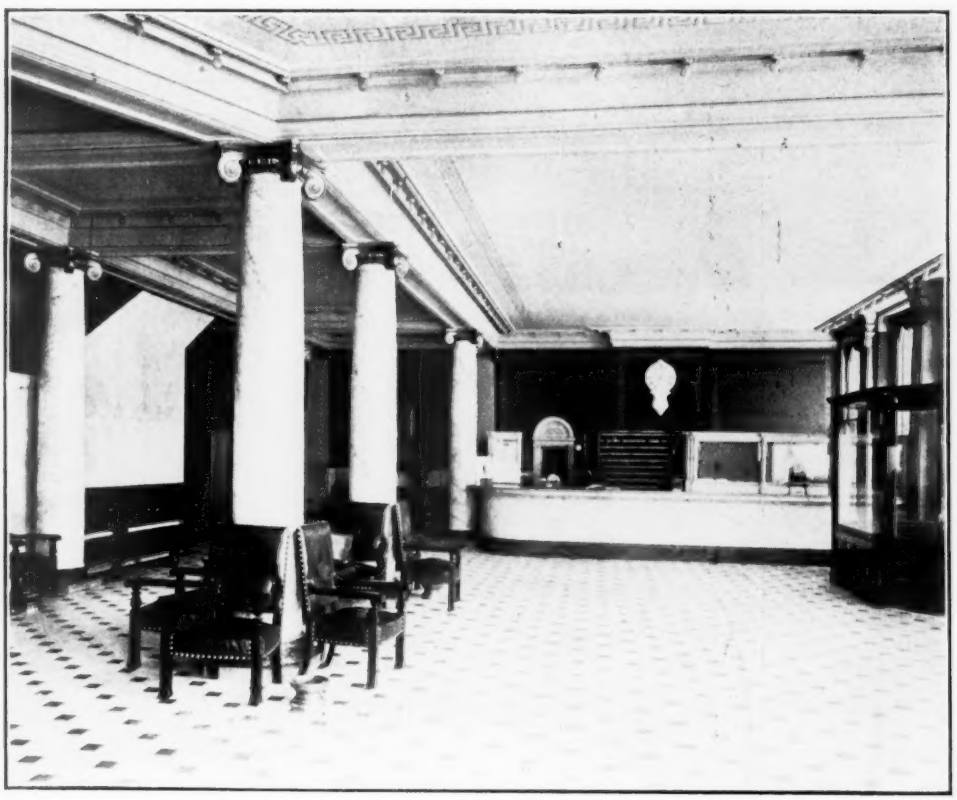
THE EXHIBITION HALL.

One floor has been set apart for exhibition purposes, and those interested in manufacturing or dealing in foundry supplies or equipments of any kind are invited to make such a display of their goods as may seem to them proper.

A large number of spaces have already been applied for, and the Committee report themselves as being highly pleased with the success of their experiments thus far.

THE PAPERS THAT WILL BE READ.

The titles of the various papers arranged for thus far and their authors are as follows:



RUSSELL HOUSE—OFFICE.

1. "Cupola Practice, Melting and Controlling Mixtures of Iron," by James A. Beckett, superintendent, Walter A. Wood Company, Hoosick Falls, N. Y.

2. "The Value of Chemistry in the Foundry," by S. S. Knight, chemist of the Addyston Pipe & Steel Company, Cincinnati, Ohio.

3. "Description of a Swiss Iron Foundry," by Henry Gretener. This paper will describe a large modern European iron foundry, and will be illustrated with over

HOTEL CADILLAC HEADQUARTERS STOVE MANUFACTURERS' CONVENTION.

WAYNE HOTEL.

twenty stereopticon views. It has been prepared with the greatest care and will be very interesting to American foundrymen as showing how things are done across the water.

4. "Crucible Making and How They Should be Cared for," by John A. Walker, vice-president and treasurer of the Joseph Dixon Crucible Company, Jersey City, N. J.

5. "Notes on Pipe Founding," by S. Groves, of the Taylor, Wilson & Company, Pittsburgh, Pa.

6. "The Value and Use of the Different Alloys in Brass Founding," by F. J. Davis, of the Cowles Electric Smelting & Aluminum Company, of Lockport, N. Y.

7. "Compressed Air," by J. F. Lewis, of the Rand Drill Company, New York and Chicago.

8. "Elevators and Yard Cranes," by G. A. True, of the Whiting Foundry Equipment Company, Chicago, Ill.

9. "Chilled Castings," by E. H. Putnam, The Chattanooga Plow Company, Chattanooga., Tenn.

Other papers by prominent foundrymen have been promised and may be read at the meeting, but the foregoing are ample to inspire a series of very interesting discussions to say nothing of the value of the papers themselves.

THE COMMITTEES' REPORT.

Among the other subjects that are going to command a large share of the Convention's time will be the reports of the two very able committees appointed to consider two important subjects.

A DEFENSE ASSOCIATION POSSIBLE.

The committee, consisting of W. H. Pfahler, of the Abram Cox Stove Company, Philadelphia; Wm. Yagle, of Wm. Yagle & Sons, Pittsburgh, and E. H. Putnam, of the Chattanooga Plow Company, having in charge the matter of investigating the necessity of establishing a Defense Association, has had a meeting in the city of Detroit and agreed upon a report that is now in the hands of the Secretary of the Association.

In this report they take a very decided stand in favor of forming such an association, and give their reasons for reaching that conclusion and submit ideas as to the best methods to be pursued to carry out the plan in a series of recommendations.

HOTEL NORMANDIE.

The subject is going to give rise to plenty of debate, as its importance will be recognized at once, and all the orators present are certain to give expression to their views.

If the recommendations of the Committee bear immediate fruit and a Defense Association is perfected, the organization will have proved the value of its existence and proceed to a long career of usefulness and benefit to the foundry of America.

THE APPRENTICESHIP QUESTION.

The other committee, consisting of C. S. Bell, C. S. Bell Company, Hillsboro, Ohio; R. Viall, of Brown & Sharpe Mnfg. Company, Providence, R. I., and Wm. Ferguson,

CHAIRMAN EXECUTIVE COMMITTEE,

JOHN R. RUSSEL,
RUSSEL WHEEL AND FOUNDRY CO., DETROIT.

of the Gates Iron Works, Chicago, who have the apprenticeship question in hand, are likewise certain to present a report of unusual interest.

It is the thought of a great many foundrymen that a universal apprenticeship system is the need of the hour, and the success of the Committee in solving this problem together with the nature of the suggestion they may make will be looked for anxiously.

THE WELCOMING ADDRESS.

The Convention will be welcomed to the city by Mayor W. C. Maybury, Detroit's newly-elected Executive, and after welcoming addresses by the representatives of the local committee, the reports of the officers of the Association itself will be in order.

After these are disposed of and routine business got out of the way, the reports of the two previously mentioned committees will be taken up, and such action as the Convention may decide will be taken. Afterwards the various papers referred to will be read in the order given, except where Association business may present itself, and be given precedence. It is, therefore, impossi-

TREASURER EXECUTIVE COMMITTEE,

OLIVER PHELPS,
MICHIGAN PENINSULAR CAR CO., DETROIT.

ble to assign at this date any special time for any particular subject.

THE ENTERTAINMENT COMMITTEE.

Then, again, the Entertainment Committee have a somewhat elaborate programme arranged for and do not desire to interfere with the regular work of the Convention. They realize fully that this meeting will have a large volume of important business awaiting its attention and do not desire to make any definite plans that will conflict, consequent-

ly the week's programme can be hardly announced before the meeting is called to order. They have, however, decided to give the visitors a river and lake excursion on Tuesday, May 11th, and a reception on the evening of Wednesday, May 12th.

The local committee in charge of this work has been subdivided into various sections, as follows:

EXECUTIVE COMMITTEE.

John R. Russel, chairman, Russel Wheel and Foundry Co.

John A. Penton, secretary, publisher THE FOUNDRY.

Oliver Phelps, treasurer, Michigan Peninsular Car Co.

CHAIRMAN SPECIAL COMMITTEE ON DEFENSE ASSOCIATION,

W. H. PEAHLER,
ABRAM COX STOVE CO., PHILADELPHIA.

Harry S. Hodge, S. F. Hodge & Co.

W. J. Keep, The Michigan Stove Co.

Thomas H. Simpson, Michigan Malleable Iron Co.

FINANCE COMMITTEE.

Harry S. Hodge Chairman, S. F. Hodge & Co.

Geo. H. Barbour, The Michigan Stove Co.

Clarence Carpenter, American Radiator Co.

T. S. Christie, Frontier Iron Works.

Lafayette Crowley, Detroit Stove Works.

James Dwyer, Peninsular Stove Co.

John M. Dwyer, Peninsular Stove Co.

Wm. Gerhauser, Superior Charcoal Iron Co.

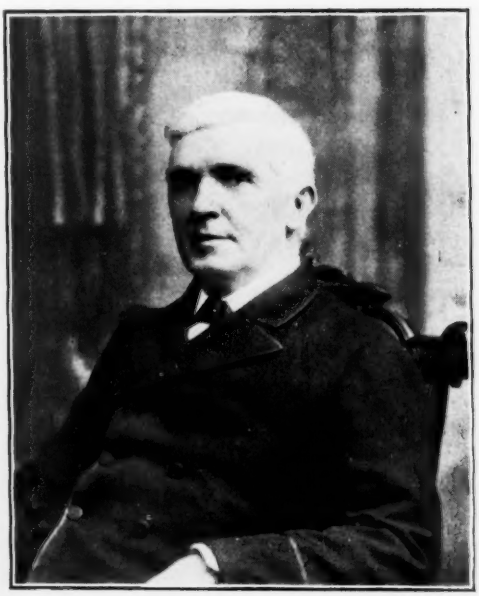
H. G. Lobenstine, Crescent Brass and Iron Works.

G. N. McMillan, Dry Dock Engine Works.

Neil McMillan, Art Stove Co.

Thomas Murphy, Murphy Iron Works.

CHAIRMAN SPECIAL COMMITTEE ON UNIFORM APPRENTICESHIP SYSTEM,



C. S. BELL,
C. S. BELL CO., HILLSBORO, OHIO.

A. A. Parker, A. A. Parker & Bro.

Oliver Phelps, Michigan-Peninsular Car Co.

Johnston Stuart, Co-Operative Foundry Co.

E. A. Sumner, American Radiator Co. (Detroit Plant).

M. F. Conklin, Fulton Iron and Engine Works.

ENTERTAINMENT COMMITTEE.

Thos. H. Simpson, Chairman, Michigan Malleable Iron Co.

E. S. Barbour, 2nd, Michigan Stove Co.

Geo. W. Cope, The Geo. W. Cope Pattern Works.

C. A. Ducharme, The Michigan Stove Co.

Wm. A. Dwyer, The Michigan Stove Co.

Wm. H. Dwyer, Peninsular Stove Co.

F. B. Gaylord, Superior Charcoal Iron Co.

F. A. Goodrich, F. A. Goodrich & Co.
F. W. Hodges, American Radiator Co.
James Inglis, American Blower Co.
W. F. Jarvis, Wm. F. Jarvis & Co.
Frank E. Kirby, Dry Dock Engine Works.
De Witt Loomis, Detroit Steel and Spring Co.
E. E. Mann, American Radiator Co. (Michigan Plant).
W. Howie Muir, Jenks & Muir Mnfg. Co.
B. W. Parker, A. A. Parker & Bro.
Thos. H. Simpson, Michigan Malleable Iron Co.
F. B. Stevens, General Foundry Merchandise.
E. A. Wales, Griffin Wheel Co.
Jas. W. Weldon, Art Stove Co.
C. W. Thomas, The Roe Stephens Mnfg. Co.

RECEPTION COMMITTEE.

W. J. Keep, Chairman, The Michigan Stove Co.
D. D. Buick, The Buick & Sherwood Mnfg. Co.
C. B. Calder, Dry Dock Engine Works.
John O. Campbell, Art Stove Co.
Jeremiah Dwyer, The Michigan Stove Co.
R. H. Freiss, Walkerville Malleable Iron Co., Walkerville, Ont.
G. B. Gunderson, The Detroit Stove Works.
J. G. Johnson, Michigan-Peninsular Car Co.
H. M. Leland, Leland & Falconer Mnfg. Co.
W. S. Russel, Russel Wheel and Foundry Co.
John Smith, Jr., S. F. Hodge & Co.
Joseph Springer, Michigan Iron and Brass Works.
Chas. J. Stuart, Co-Operative Foundry Co.
Duncan Symington, Frontier Iron Works.
D. H. Roberts, The McRae & Roberts Co.
Wm. Scott, The Roe Stephens Mnfg. Co.
Frank E. Beal, Fulton Iron and Engine Works.

All have lent themselves to the work in hand with the greatest energy possible. There is no longer any doubt about the success of the meeting; it is going to be a winner from the start, and the foundrymen who can get away and does not come will be always sorry.

The President's invitation makes no distinction between those who are members and those who are not; all are welcome and all are sure to enjoy themselves.

Examples of Shop Practice.

By HENRY HANSEN.

The individual, so much in evidence in the past, who insists that he is doing work in the only legitimate way, is fast disappearing. The man who stands ready to change his

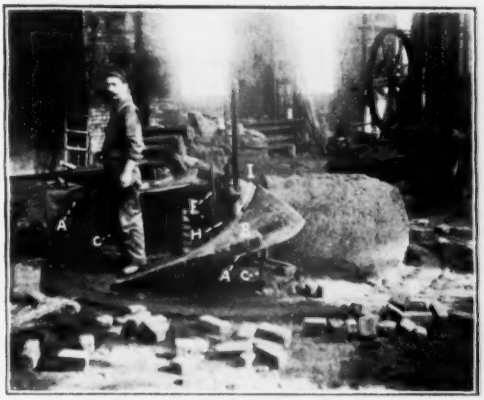


FIG. 1.

ideas, when confronted with others superior to his own, has an advantage over those who persist in employing fixed methods. We may say that to-day there is practically no such

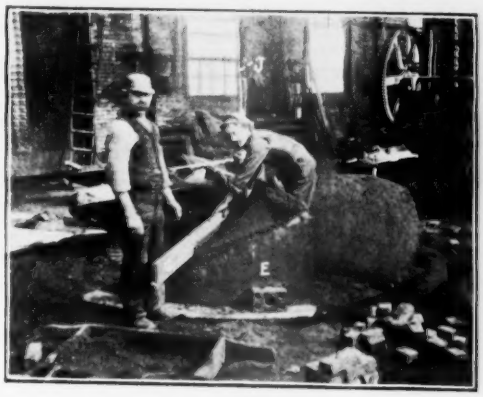


FIG. 2.

thing as a standard in molding, for what may be good practice at the present will soon be superseded by something better. Then foundry literature aids the interchange of ideas and forms a medium through which shops are constantly arriving at a better shop practice. The man who learns something in this way reciprocates, with the result, that the

best practice can be gathered in a fraction of the time it formerly took to obtain the most meagre information by personal investigation.

To the foundrymen or molder in love with his trade, there is nothing that appeals with a greater fascination than a crooked casting —something that he can not exactly see his way through. If he fails to find the joint line, where he thinks it ought to be or if it puzzles him how the cores overlapped one another, the chances are that he will stay along side of that casting and do some real hard thinking. He will do this if he is in love with his trade, and if he is not, he ought to be working at something else.

Through the courtesy of Mr. John Smith,

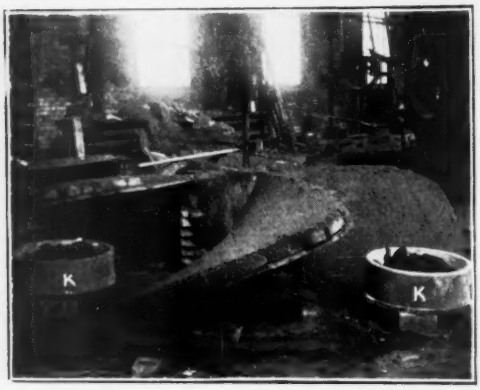


FIG. 3.

Jr., superintendent of the foundry of S. F. Hodge & Co., Detroit, Mich., the writer is enabled to illustrate the method in vogue at that place for turning out propellers. But few writers on foundry matters have taken up this part of the trade, doubtless because the general crookedness of the subject makes it difficult of illustration.

Though some propellers are made in green and dry sand, the common practice is to mold them in loam when they assume any large dimensions. A one-blade pattern is also sometimes provided and again a skeleton pattern of the blade is used to facilitate molding. In the present instance no pattern is used outside of the hub pattern, which is made with a separate center, and an outside covering forming the hub, thus allowing the hub pattern to be withdrawn without having to resort to the extra work of making a parting half way down on the hub, and employing a drawback for each blade, a very common practice.

Fig. 1 shows the appearance of a mold for a propeller in its early stages of development. Ordinarily, the lower or drag side is built up of brick clear from the bottom plate,

FIG. 4.

while in the present instance each blade is supported by a plate A A, on which is laid a single course of bricks, as shown at B. These plates are in turn supported by the brackets C C, the upper end of which is bolted to the plate A, and the lower resting

FIG. 5.

on the bottom plate, underlying the mold, this being provided with suitable holes or hooks through which T bolts or other arrangements for securing any part of the mold can be made. Not only does this method do away with a great deal of extra work in bricking up a solid wall, but the

time saved in drying a mold is also very much in its favor. Those who have been compelled to dry large masses of solid brick know best what time is required to eliminate the moisture and to make it in perfect condition for casting.

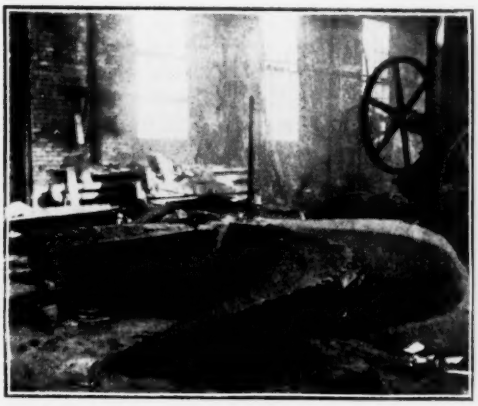


FIG. 6.

At D is shown the bearing swept up on which rests the inclined frame or guide E, Fig. 2, for sweeping the outer end of the blade. A similar bearing has been prepared at the center for the inside guide F, the sweep G in its travels being thus made to follow the position of E F. From this it

FIG. 7.

follows that while the sweep is at all times held in a horizontal position by the spindle, its lateral position is a constantly changing one. To enable the sweep to make this change a double-jointed connection H I is used, I permitting the sweep to move vertically, while H allows it to change its lateral position. Sweeps that are wanted to move vertically are generally counterbalanced to permit of easier operation, the rope J leading to a weight, not shown, for this purpose.

In the present instance the face side of the propeller is made downwards, producing not

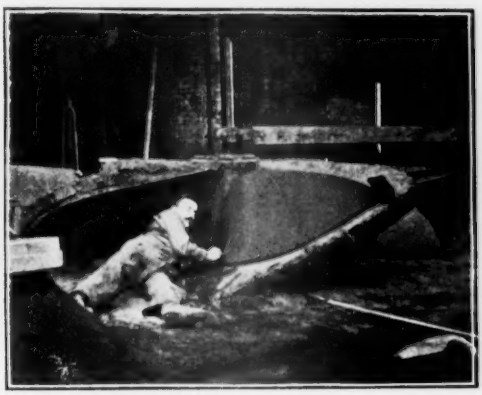


FIG. 8.

only a casting clean on its working side, but what is more important, a perfect blade. The efficience of a propeller depends not only upon a correct construction but also upon the perfection with which this is finished. A blade with irregular swells will certainly consume more power and cost more to keep

FIG. 9.

in operation than one conforming to all reasonable specifications it could be demanded to meet.

Fig. 3 shows the mold with the bottom side of the four blades swept up and ready to be dried, which is done by a small fire in

each of the grates K K, one of these being placed between each blade and the whole covered with a curbing and sheets of iron, as shown in Fig. 4. By drying the mold in the place it is rammed up, the pitch of the propeller is compelled to remain as originally

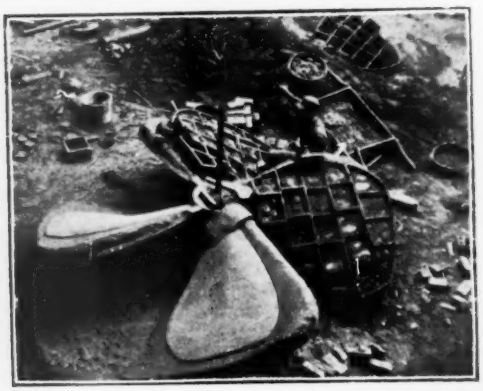


FIG. 10.

made, while with molds that are separated and placed in the oven to dry, there is a chance, that this may be changed in readjusting the mold.

After being dried, the mold is ready to have the blades built of green sand, which thus forms a pattern over which the copes may be built. As was said at the beginning of this article, skeleton patterns are some-

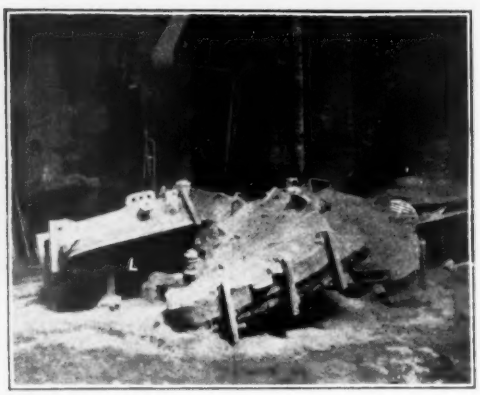


FIG. 11.

times furnished, which the molder fills with green sand, following the outlines of the skeleton. As one propeller may be wanted to differ from another in weight to suit the ideas of different engineers it requires considerable pattern work to make even skeleton patterns. Therefore propellers made in this shop are made entirely without such, the only guide the molder has to go by being certain dimensions furnished him, with which he makes the green sand patterns agree. After the dimensions, weight and contour have been determined upon, the blade is, by the aid of sweep and compasses, laid out as shown in Fig 5, the row of nails showing the outline with which the blade must agree, the thickness being judged by inserting a vent wire at certain points. It is surprising with what ease a molder experienced in his work will lay out a pattern and the exactness of the casting when finished. Fig. 6 shows on the right hand side one of

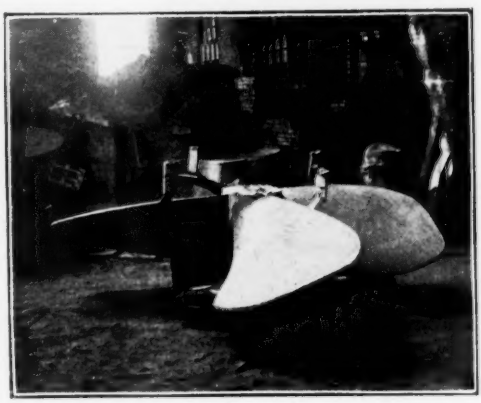


FIG. 12.

these green sand blades, ready for the cope to be built. In the foreground another blade is seen outlined with a row of nails. To save time in laying out the blades, the first one made is used as a pattern, strips of heavy paper being cut to the exact shape of the blade, which in turn serves as a guide to indicate the outlines of the one next in order. Fig. 7 shows the molder in the act of laying out a blade, a row of nails being placed as shown before.

Fig. 8 gives another view of one of the green sand patterns, and gives better than any description, a general idea of its appearance. Fig. 9 shows the copes used, in which loam and brick are employed instead of sand. Fig. 10 shows the mold in different stages of completion, the cope to the right being bricked up and ready to lift off. Fig. 11 is from a photograph taken after the mold was

cast and conveys an idea of the method by which it is clamped together, which is the same as in ordinary work with the exception of the lower side at L, where the mold is secured to the bottom plate. Fig. 12 shows the casting as it was lifted from the mold, the gates and fins being plainly seen. As no retouching has been done to either the photograph or the casting, it commends itself for the general smoothness with which it appears.

Loam work is looked upon by some founders as a synonym for expensive molding. In many cases, however, it is the green sand molding which costs the most, and while some loam work is undoubtedly expensive, the same energy which has reduced the cost of green sand work by the introduction of better appliances is also capable of effecting the same economies in this branch of the trade.

Philadelphia Foundrymen's Association.

The sixty-seventh meeting of this Association was held at the Manufacturers' Club in Philadelphia, April 7.

After a general discussion as to the state of the foundry trade, in which many members took part, Mr. Joseph Allison Steinmetz, of Philadelphia, read the following paper on

"ALUMINUM AND ITS USE IN THE FOUNDRY."

It is the purpose of this paper to treat of this development only in a brief and general manner, in order that the subject may be brought to the attention of foundry interests, and in the hopes that this introduction will lead to further experiments with and uses of aluminium metal along the lines to be hereafter sketched.

In all matters pertaining to aluminium, outside of the very narrow field of personal experience, it is necessary that reference be made from time to time to those sources of information and data which are, beyond any doubt, of absolute authenticity.

Therefore, it is with pleasure that I refer all persons who are in any way interested in this metal aluminium to the first and only comprehensive work published upon this subject, entitled "Aluminium; Its History, Occurrence, Properties, Metallurgy, and Applications, Including its Alloys," by Joseph W. Richards, A. C., Ph. D., and professor of metallurgy at the Lehigh Uuniversity. And from this excellent compilation will be made sundry quotations of those parts that are pertinent to the matter in hand.

I will not touch upon the subject of aluminium in steel castings, for the reason that the scope of this paper embraces only the cast-iron foundry practice, although it is well to state that for several years the bulk of the steel castings companies have been very large users of aluminium in their work. In fact, several of the largest concerns used steadily as much as from one to two tons of pure aluminium metal per month. In all cases it is earnestly recommended to purchase pure aluminium, whether for steel or iron castings, for the reason that you can make your own ferro-aluminium alloys of absolute and unvariable proportions, and also, as a point of economy, to pay freight on the light-weight pure aluminium, instead of the heavy alloy. We would, however, always recommend that the ferro-aluminium alloy be mixed with the molten metal, as in this form the aluminium suffers less waste than the pure metal and assimilates more easily and more thoroughly with the pour.

The high price of aluminium has heretofore been the great barrier to its general use in cast iron foundry work, but this is no longer the case, as there can now be furnished the purest 98 to 99 per cent. metal at a price that puts it within the economical use of all foundrymen, considering the advantages to be derived from its use.

As early as 1858, when the metal was almost a laboratory curiosity, the possibility of this application was suggested, as soon as its price would warrant, and that time is now.

Almost 30 years later, or in 1885, the discovery and publication of the Mitis Process caused a very general interest among experimenters and certain foundries to determine the effects produced by aluminium on cast iron.

The general advantages claimed by the exploiters of these processes, of the additions of pure aluminium and ferro-aluminium into cast iron, were very broad and attractive and may be correctly listed, for our consideration, under the following headings:

First. Makes the iron more fluid.

Second. Makes hard iron softer.

Third. Castings thus made are freed from hard spots and blow-holes.

Fourth. Lessens the tendency of the metal to chill.

Fifth. Increases the resistance of the metal to chemical action.

It is also stated that while good, soft iron is made more fluid and benefited to some degree, yet the advantages of treating with aluminium are most evident with poor, hard, white iron.

In relation to the above claims we will review them in detail and in the light of trustworthy experiments, which have been made, under the above headings, and which are properly certified to.

It is now an unquestionable fact that the addition of aluminium very considerably effects the quality of the castings for the better. The method of adding it which has been generally adopted is to put some pieces of broken ferro-aluminium into the bottom of the ladle, preferably a hot one, and tap the iron from the cupola directly on to the alloy.

A German experimenter states that it is important that the iron be not too hot when the ferro-aluminium is added, for if it is white-hot the aluminium burns with a greenish flame and a peculiar smell; a golden-yellow heat is recommended as the right heat for treatment. If the ferro-aluminium is thrown into the molten iron at this heat the streaks playing on the surface of the metal disappear, and the bath becomes blistery looking. While there have been many testimonials from practical men as to the benefits derived from the use of ferro-aluminium, testimonials so numerous that the fact of benefit has become indisputable, the only systematic investigation of this subject that is cited in Dr. Richard's work on aluminium, the text of which I have had the honor of quoting so frequently in the paper, is the series of comparative tests made by Mr. W. J. Keep, of the Michigan Stove Company, of Detroit, with the co-operation of Professor C. F. Maybery and L. D. Voree. Their results are embodied in two quite lengthy papers, one read before the American Association for the Advancement of Science at their Cleveland meeting, August 17, 1888; the other published in the transactions of the American Institute of Mining Engineers, December, 1889.

I refer to the papers as original investigations and to Dr. Richard's book, wherein said experiments are largely quoted, and as I shall take the bulk of my matter from these sources, it will be well to first explain the methods employed in pursuing these investigations.

Two kinds of iron were used, having the following composition:

	White Iron.		Gray Iron.
Silicon	0.186	—	1.219
Phosphorus	0.263	—	0.084
Sulphur	0.031	—	0.049
Manganese	0.092	—	0.187
Graphite carbon	0.95	—	3.22
Combined carbon	2.63	—	0.33
Total	2.380		3.550

The ferro-aluminium used contained 11.42 per cent. of aluminium and 3.86 per cent. of silicon.

The melting was done in a covered plumbago crucible, and the melt was run into test-bars, one foot long, some having a section one-half inch square; others one inch wide and one-tenth inch thick. The ferro-aluminium was added to the molten iron, the smallest quantity first, and, after casting, part of this first cast was remelted with more ferro-aluminium, and so on.

Another series of heats was made under exactly the same conditions, but without adding aluminium, these tests serving for comparison and determination of the true effect of adding the ferro-aluminium.

The general scheme of the tests consisted in adding 0.25, 0.50, 0.75 and 1.00 per cent. of aluminium to the white iron, and 0.25, 0.50, 0.75, 1, 2, 3 and 4 per cent. to the gray iron, the test bars being carefully examined as to strength, shrinkage, etc., and comparison made with the corresponding remelt of the iron alone. The weak point of the first set of tests, recorded in the first paper, was the fact that many of the changes credited to the addition of the ferro-aluminium might probably have been accounted for by the silicon in the alloy added, and so the results could not be accepted as demonstrating the influence of the aluminium except where the change was in a direction contrary to that which the silicon could have produced.

Mr. Keep recognized at once the necessity of differentiating the effect of these two elements, which was accomplished very ingeniously by finding an iron containing the same amounts of silicon, carbon, etc., as the ferro-aluminium, and making comparison tests with this iron in place of the aluminium allow; also by adding pure metalic aluminium to the iron. Since Mr. Keep's method of presenting his results is in some cases not easily understood, Dr. Richards, from an inspection of his diagrams, recast these results into tabular shape, and reference and tribute is again made to the doctor's great work on "Aluminium."

Solidity of Castings.—All of Mr. Keep's tests bore on this point, but one particular tests was made with white iron, adding only 0.1 per cent. of aluminium (0.03 of silicon). The castings were of slightly finer grain, but blow-holes and interstitial cavities were noticeably absent, this accounting for the largely increased strength. The resistance to dead weight was increased 44 per cent., and to impact 6 per cent. No check test was made to eliminate the effect of the silicon added, but the effect produced was much greater than can with any probability be ascribed to the silicon alone.

Transverse Strength.—The addition of aluminium in the form of ferro-aluminium has the general effect of strengthening the iron, the white iron showing the greater improvement, and the resistance to impact being increased more than the resistance to dead weight.

The following table gives the percentage increase in strength in each case, the minus quantities in parenthesis meaning decreased strength:

Percentages of Aluminum.	White Iron.		Gray Iron.	
	Dead Wht.	Imp't.	Dead Wht.	Imp't.
0.25 equals	32.5	82.8 equals	— [12.5]	— [15.5]
0.50 equals	128 0	291.0 equals	— [8.9]	[44.0]
0.75 equals	113.6	240.0 equals	5.8	23.0
1.00 equals	117.6	350.0 equals	2.4	30.0
2.00 equals		equals	— [10.4]	29.0
3.00 equals		equals	4.6	11.0
4.00 equals		equals	15.8	13.0

Since, for every 1 per cent. of aluminium added, 0.34 of silicon was contained in the ferro-aluminium, the question very naturally occurred, how much of this benefit was due to silicon. Tests were therefore made on this point, proving the part taken by the aluminium. The figures show the percentage increase in strength, as in the former tables:

Additions.	White Iron. Dead Weight. Per Ct.	White Iron. Impact. Per Ct.
1 per cent. aluminium as ferro-aluminium	117.6	350.0
Cast iron, introducing the same quantity of silicon	126.8	94.6
1 per cent. of aluminium, as pure aluminium	141.7	156.5

The conclusions to be drawn are, therefore, that while the silicon in the ferro-aluminium is sufficient to explain the increased resistance to a dead weight, yet the increase in resistance to impact is clearly due in large part to the aluminium.

Elasticity.—The closing of the grain of the iron on treatment with ferro-aluminium caused the iron to be less brittle, or more elastic.

The deflection of the different specimens for a fixed weight was measured, and the increase in deflection was found to be (in percentages)—

Pr'c'tages Aluminium.	White Iron	Gray Iron
0.25	31	125
0.50	89	116
0.75	100	147
1.00	153	133
2.00	—	133
3.00	—	194
4.00	—	193

To distinguish the effect due to the silicon added, tests made with silicon and aluminium alone showed increased deflections, as follows:

Addition.	White Iron.
1 per ct. aluminium in ferro-aluminium	153
Cast iron containing equal quantity silicon	11
1 per ct. aluminium as pure aluminium	100

It is thus proved that the increased elasticity is due to the aluminium, caused, as Mr. Keep believes, by a very uniform distribution of the graphitic carbon when aluminium is the element precipitating it.

FLUIDITY OF THE IRON.

The general conclusion from tests made is that with white iron small additions of aluminium, such as would be used in ordinary foundry practice, increases slightly the fluidity; one-half per cent. of aluminium and over decreases the fluidity.

Gray iron is rendered decidedly less fluid by any addition of aluminium.

Shrinkage.—The shrinkages of the various test pieces were carefully noted, with the general conclusion that the aluminium reduces the shrinkage if enough is added. This development, though of interest, will not warrant a lengthy discussion, as the idea is to bear more upon the physical characteristics of the iron treated, as noted under headings of Elasticity, Soundness and Strength.

Aside from the determinations of Mr. Keep and the other cases cited in Dr. Richards' book, many testimonials could be quoted from practical iron founders if space would allow, as to the practical benefit to poor iron gained by adding ferro-aluminium.

Perhaps one of the most striking results is the increased time which the aluminium-treated iron will remain molten. For instance, Mr. Keep found that 0.02 per cent. of aluminium added to a ladle of iron caused it to keep fluid five minutes, while a similar ladleful of the same metal without aluminium became solid in half that time.

This property of keeping fluid longer is of direct usefulness in a foundry where it is necessary to run a large number of small castings, during which operation there is usually much trouble in keeping the ordinary melt fluid, unless it was very hot to start with. The advantages therefore are evident.

Dr. Richards cites the experience of a friend who described an experiment in which a large ladleful of iron was tapped from a cupola and taken for pouring about 200 yards, partly through the open air. The iron was not hot enough to fill the moulds satisfactorily. Another ladleful, similar in all respects, was tapped immediately afterwards some ferro-aluminium being placed in the ladle. This iron was taken to the same place for casting, filled the moulds perfectly, and when brought back to the cupola the metal in the ladle was still fluid enough to make good castings.

The general results prove that the molten bath of iron will stay fluid twice as long when treated to aluminium as when run out as ordinary. The other considerations are that cleaner, more solid and softer castings are universally obtained, and at that with a large reduction in the percentage of defective castings. Therefore, after a judicious summing up, we would state boldly that very small percentages of ferro-aluminium added to unsatisfactory and poor iron will result advantageously.

The field is open to investigations and further work along these lines, and we shall always be glad to give anyone desirous of looking into this matter, our best attention and advice.

At the conclusion of the reading a vote of thanks was taken and tendered to the reader.

Mr. Glover—Where can Prof. Richard's book be purchased?

Mr. Steinmetz—I have a prospectus concerning it here.

Mr. Evans—I may state that I have made some inquiry among foundries as to the results obtained by the use of aluminium, either in the pure state or in 87 or 90 per cent pure state, or in the ferro, and while every foundryman in this section of the country seems to be impressed with the use of aluminium, as tending to close up the pores and make a more solid and homogeneous casting without adding much strength, I find they did not continue to use it. I should like to know why it is that foundrymen as a rule do not use it.

Mr. Steinmetz—I think the barrier heretofore has been the cost of the metal, which used to run from 50 cents per pound upwards. The metal can now be bought in the neighborhood of 30 to 35 cents and is therefore becoming more attractive. It was at one time $2.50 to $3.00 and even $5.00 per pound. The bulk of what is supplied for foundry use has gone to the steel casting people. Cast iron foundries are using it in a small way, but I do not believe they use 10 per cent of what the steel foundries use. Perhaps steel castings are harder to make and have different physical properties to overcome. There is surely someone here who has used it, and it would be well to hear what they have to say, as the informa-

tion would come direct. It has wrongly been considered as the panacea for all ills, consequently a distorted idea as to its use has gone abroad.

Mr. Moore—A few years ago we commenced to use it. We were at that time making ice machines and fittings that would hold ammonia gas. We bought some material and used quite a lot of it, and met with a great deal of success in making close, strong castings that would stand the test of heavy pressure of ammonia gas. We were satisfied with what we were getting, but soon afterwards a man came along and wanted to sell us some aluminium. We were, as we supposed, getting ferro-aluminium from another party, and I told him we were well satisfied. He asked to see some of it, and being shown it at once said: "That is not aluminium at all, someone has been sticking you." I said I could not help that, it suited us all right. Finally we were unable to procure any more from the man who had sold to us, and we also shortly afterwards went out of the ice machine business. Whether we were using aluminium or not I do not know.

Mr. Steinmetz—There were on the market, as recently as five years ago, a considerable number of miscellaneous mixtures, marketed under the heading of ferro-aluminium. I have a great suspicion that they did not contain a particle of aluminium. It was natural that the metal should not be known, and perhaps the man who sold to Mr. Moore did not himself know it. When using aluminium it would be best for the individual to purchase the metal and make his own proportions. The old plan was to put in this so-called ferro-aluminium, and not knowing what it really was, absolute failure generally resulted. There is no reason why aluminium should not be more widely used, and it is worth while to investigate it.

Western Foundrymen's Association.

The regular monthly meeting of this association was held at the Great Northern Hotel, Chicago, April 21, Mr. Wm. Ferguson presiding.

The only business before the meeting was the discussion of the proposed amendments to the by-laws and the nomination of officers. The following nominations were announced:

President—C. A. Sercomb, Wm. Ferguson, W. N. Moore.

Vice-President—Wm. Ferguson, R. Cleveland, C. A. Sercomb, E. W. Smith.

Secretary—B. M. Gardner, A. Sorge, Jr., S. T. Johnston, H. S. Vrooman.

Treasurer—O. T. Stantial, S. T. Johnston, G. H. Carver.

Directors—G. H. Carver, J. M. Sweeney, A. W. McArthur, W. N. Moore, H. L. Hotchkiss, Geo. M. Sargent, S. T. Johnston, F. M. Lyon, A. M. Thompson, C. A. Sercomb, R. Cleveland, W. A. Jones.

Editing Committee—B. M. Gardner, Henry W. Carter, E. E. Hanna, H. F. Frohman, Wm. Ferguson, R. Barr, A. Sorge, Jr.

The Modern (?) Foundry.

PART II.

In the last issue of THE FOUNDRY, an article under this heading devoted considerable space to a description of an old foundry plant which, with very incomplete equipments, and they bordering on the verge of ruin, as had been their condition for years, entered into competition with a well-rigged, progressive foundry, and sometimes successfully bringing out thoughts which do not receive sufficient attention.

The idea that fine buildings, modern machinery, a good bank account, noted mechanics and an elegantly furnished office, denote cheap production and a profitable business, often exists simply in appearance, yet often only to an extent hardly deemed possible in the business world.

The true guide as to the cost of castings is not determined so much by the cost of labor employed in its production, or the facilities used, as by the fixed charges, or expenses, aside from the actual labor necessary for its accomplishment, or the kind of workmen employed and quality of work produced. The producers—the men who actually make the dollars—are seldom the cause of expensive production. Although they are the men who stand the first reduction, the decreased wages and hours, they are the ones who suffer most, except, possibly, the owners, from every business depression. But the non-producers—the office men, superintendents, foremen, teamsters, watchmen, and others who have been employed during

prosperous business periods, the practically non-producing element of the plant, the men who draw their salaries by the month or year, and occupy their desks or respective positions daily, whether the shop is running twenty hours a week or sixty, whether the concern is turning out two or twenty thousand dollars' worth of goods per month, who do nothing by their own physical efforts to increase the output, become a burden, and rapidly eat up all the profits when the number of employes or producers is reduced, or contracts taken at close profits.

The grade of mechanics employed, and quality of work produced, also enter largely into a consideration of its cost. Poor mechanics mean poor work, not alone in pounds of bad castings, but in the quality of what is considered acceptable.

There is little difference in this country between the pay of a good mechanic and a poor one, nothing like there should be, for then merit would receive its reward and inferior men be placed where they belong. But the idea with which some manufacturers delude themselves, that a mechanic who can be procured for twenty-five or fifty cents per day less than the market price are cheap and economical men to hire, is an absurdity. A cheap man is always an inferior man: if not, he doesn't occupy a cheap position long, but being of inferior ability, naturally makes more bad work, or turns it out of a kind which not only injures the firm's business, but causes enormous annoyance and expense. A bad casting is almost truly defined when the expression "lost" is applied to it, for when you add together the molder's time, the coremaker's labor, the labor and cupola expenses, the loss in melting and cost of fuel, the office charges for general expenses, and the lost profit for that piece, you will have a sum that will nearly always amount to the entire cost of the casting. Rough or unsatisfactory work also brings similar losses; returned castings mean that it will take four or five times the amount of good castings to equalize the loss, and sometimes more.

The writer was once acquainted with an establishment which kept a man on the road all the time to correct and heal the wounds of people who had received defective work, and if the salary and expenses paid to this diplomatic agent had been expended on the wages of their molders, a better class of mechanics would have been found in their shop and more satisfactory work furnished their patrons. Very often an added expense of three or four dollars per day in the wages of the best mechanics in a moderate sized plant would repay itself an hundredfold. Good flasks and patterns, good facilities of any or every description, will undoubtedly assist in producing cheaper and better castings; but a slovenly, careless molder will make rougher work than one who is studious and painstaking, for the innate nature or character of a man will show itself, no matter what his surroundings are. It is almost painful to see a molder of this type receive a good casting to make, a nice new pattern, which you know will come from the sand bruised with rammer marks and splintered from the point of the vent-wire, a new flask which will show serious injury from the sledge or fire, and a casting produced which you desired to run your hand over and pronounce with a feeling of pride "as smooth as a peeled onion," but instead as rough as a piece of pig iron just from the furnace, it absolutely causes a cold chill to run down your back—it's like putting a pig in the parlor and expecting him to understand etiquette.

When business is dull, and contracts hard to procure, the proprietors often seek to force or stimulate their business by low prices and close profits, and when the result is not as beneficial as they expected; that instead of filling their shop with orders, they reduced the price on what little they were doing, much of which would have found its way to their doors at the old price, and the monthly report begins to show up bad, the first blow struck is aimed at the workmen—wages must be reduced. This is not always accomplished by a direct cut, but numerous expedients are resorted to for the purpose of procuring labor at a lower cost to the employer; a reduction of hours, with the expectation that men will do as much work in eight hours as formerly in nine or ten; a cutting off, a pruning out in every possible place, consolidating three men's work on two, and expecting just as thorough and efficient service as before, are

all pleasant little methods of reducing the workman's remuneration without being pointed out as the author and perpetrator of that distasteful word to American laborers, a "cut." Yet how seldom the true cause of increased expense is investigated, or, if recognized, corrected in the place it really exists. Office salaries and general expenses, which in prosperous times only added ten per cent to the cost of production, may in a season of depression easily grow to twenty per cent. Is not this in itself enough to take the profit from almost any business, coupled with the fact that in such times prices are usually lower instead of higher? The cost of production, of labor, will remain normally the same for the tons of castings, or number of pieces produced, yet they, the producers, pay the penalty. Does the office reduce their force and expenses to conform to their business? Does not the bookkeeper who received $100 per month for looking after twenty thousand dollars' worth of business receive the same compensation for looking after ten thousand? Do the officials cut down their own salaries until every other means is resorted to?

These facts are natural, we know. It would be strange if men did not look after their own interest first; but from a business point of view there is a startling inconsistency in much of the practice. Here and there a mechanic will be laid off, forcing more work on the remaining producers, cutting down possibly in a small way their production for the purpose, as they fondly imagine, of saving two or three dollars per day.

Assume, for example, that a foundry employs ten molders, who each turn out on an average 1,000 pounds of castings daily, receiving for their toil $2.50 per day, which would make the cost of molding $5 per ton; also assume that cupola, core room and labor expenses amount to $4 per ton, making a total of $9 per ton for labor, and at this time a period of depression and low prices strikes them, so that the force can only be employed on half time. A reduction of 10 per cent in wages will mean 90 cents less per ton, or ten molders at full time and pay produced five tons of castings for $25 for six days in the week, all labor included, thirty tons of castings for $270, while with reduced wages and half time, produced fifteen tons of castings for $121.50, a saving, you might say, of $13.50 per week through the reduction.

The office expenses of such a plant, it is safe to say, will run $75 per week, with a full force of men working, the expense per ton would be $2.50; but should it also be reduced 10 per cent, corresponding to the men's reduction, and half time be run in the shop, while office expenses go on, the reduction would amount to $7.50 per week; but the added cost of reduced tonnage would bring it up to $4.50 per ton, or a loss of $30 a week here, against a saving of $13.50 on the laborers and mechanics.

When molders or laborers are not required around a plant—when there is not enough work to keep them profitably employed—they are laid off, and their pay ceases. Nothing else can be expected or demanded; but when this condition comes, why are not office expenses reduced in the same manner? Sometimes it is said that it is not profitable to change a good bookkeeper, clerk or foreman, to lose them during a slack time and have to hire new men when business revives; but it is no more so than to let a good mechanic or laborer go in the mechanical department. The only difference, in reality, arises from the fact that in the former case the proprietors dislike the trouble and expense of breaking new men to the routine of their business, while in the shop the foreman or superintendent is considered as hired for that purpose and possibly he is—that cannot be denied—but it is no more economical to keep a good clerk, when you don't require his services, than to keep a good mechanic when you have no employment for him.

The old man, in his old, dilapidated foundry, showed how true this was, by having no men except producers, and consequently no office expenses, and more fully and practically, by competing successfully with well equipped concerns. It is not to be suggested his example is worthy of emulation by our well-to-do establishments, that in order to succeed in business we must settle down into an apathy of indifference or neglect, never seek to improve or increase, or let the buildings and tools go to ruin. But in one instance his example is worthy of consideration—he made his current or running expenses proportionate to the amount of business he was doing.

We appreciate the fact that it is nobody's business if a firm decides to spend their earnings in their office. They are perfectly justified in handling their money as it suits them; but it sometimes calls forth a wearisome feeling to hear employers complain bitterly of hard times, with nothing to do, their men making two or three days per week, and all office expenses remain the same. It is just as economical as using a hundred-horse-power engine when only fifty-horse-power is required. It matters not if office salaries are large, or if the force is numerous, if the business actually justifies it; but unless some recognition is taken of these things, depression will bear most severely on the plants doing a large and well-advertised business.

There is another point in practice along the line of office expense as equally inconsistent as those mentioned, and one not based on good business principles. The majority of foundries have some special or set grade of work which they make regularly, and constitutes the bulk of their business and greater portion of their profits, because it is being constantly duplicated, and facilities are constructed and men drilled in its economical production; also requiring very small office expense for the same reasons, a few days each year to make contracts, prices and discounts regulated by forms or circulars, requiring little time or attention; yet in nine cases out of ten the most money is made, and the soundest business carried on in this class of work. Still there are many establishments who spend hundreds of dollars every month trying to obtain a part of the business that is in their district, but outside of the general run of their work, the time of high-priced men to make estimates and figure upon contracts which never materialize, or if they do, must be taken at figures to compete with specialists in that line; the enormous correspondence, the expense of travel to look after possible jobs, which if procured even at a better price than their general work, will in the end cost more. Several establishments of this kind have come under the writer's notice, where the regular work was made at a profit, but the expense incurred in trying to reach everything through a liberal office expenditure ate up all the profits. When a job of work in the shop don't pay the contract is seldom repeated; and why should office expenses be continued when they do not pay and return some reward for their use?

If a concern desires to do more business, let them adopt more specialties, equip and inform themselves in new lines, and do it thoroughly, so that when they enter the field of competition it will be as an equal with those they bid against, and not as an ignorant experimenter in every department of the trade. The general foundry is growing more rare each year, except in isolated positions, and those awake to the conditions are fitting themselves to excel in one or more particular grades of work.

Melting Aluminum.

An English journal devoted to the interests of aluminum gives the following directions in regard to the melting of that metal: Large quantities of aluminum are melted in a reverberatory furnace, and in this case the hearth should be lined with carbon, wood or gas being used as fuel. The cleanest way is decidedly to melt it by electricity, but this process is, of course, not always available. In the large Continental works, where one-quarter of a ton is often melted at one operation, basic magnesia bricks are employed, similar to those used in basic open hearth furnaces, but made of purer materials, and they are all that can be desired in their capacity for resisting corrosion. The heat should never exceed a dark red. Notwithstanding its low melting point, aluminum requires much time and heat for this process—a consequence of its high specific heat, and its latent heat of fusion. Another consequence of these properties is that the metal, if overheated, has to stand an exceptionally long time before it has cooled down to the right temperature for casting. Forty to sixty pounds of aluminum, heated to a bright red, take from twenty to thirty minutes to cool to a fit condition for pouring into the mold. It is, therefore, best to make a small fire, keep it steadily going on, and wait patiently till the metal melts; generally this will occur in about three-quarters of an hour.

We think THE FOUNDRY makes a good encyclopedia. E. D. NICHOLAS.

Renood, Pa.

A TECHNICAL JOURNAL DEVOTED TO FOUNDRY INTERESTS.

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The Western News Company, Chicago, Ill.
The Williamsburg News Co., Brooklyn, E. D., N. Y.
The Wisconsin News Company, Milwaukee, Wis.

Trade Outlook.

It is pointed out with a great deal of satisfaction that there are no more pools directly connected with the iron trade to collapse. This does not necessarily mean that we are going to have an era of lower prices, for pools very often depress these in order to obtain a more complete control of the commodity in which they deal. It means, however, that the laws of supply and demand will for a time regulate the prices of the iron industry. We say, for a time, because there is every reason to believe that combinations will be made at some future time. The past has witnessed a continual formation of pools, attended with more or less success it is true, but despite all failures of these to last for any great length of time, the chances are that new ones will be formed and that before anyone suspects a move of this kind.

The disruption of the Bessemer ore pool; which was followed by a reduction in price of standard Bessemer ores from $4 to $2.65 per ton, has had but little effect upon the price of the non-Bessemer ores from which foundry pig iron is made. This has caused surprise among buyers of foundry iron, who were confident of a further break in the price of pig iron. The reason this has failed to materialize is because there has been no agreement in the past as to the price of non-Bessemer ores, hence these have all along been sold at whatever prices they would bring, and consequently are not affected by any artificial prices that may have been in force for low phosphorus ores. It is also pointed out that every improved facility so far discovered for turning out iron at the least cost is employed at the furnaces, and that no further reduction in price of iron can be made without reducing the wages of the operatives. As such a step might lead to serious complications it is extremely doubtful that this will be resorted to. The foundry which is delaying its purchases of pig iron in the hope of lower prices is therefore likely to receive but little encouragement.

Some anomalies are being shown in drafting the tariff bill now under consideration. The iron manufacturers of eastern and middle Pennsylvania, New Jersey, Maryland and Virginia object to a duty of 40 cents a ton being placed on foreign ore, which they need to mix with the ores found in these

localities. They claim that this will prevent them from competing with the furnaces west of the Allegheny mountains using Lake Superior or southern ores.

The output of furnaces has for the past few months been in excess of demands and stocks have accumulated. Reports indicate that a number of furnaces are preparing to go out of blast, though none of them appear to take the initiative.

Cheap Labor.

Occasionally a word of truth does come from the halls of congress, amid all the wind jamming generated in that quarter. In a recent debate on the tariff Mr. Dalzell, of Pennsylvania, said that convict labor was one of the main elements in cheap production of iron in Tennessee. Mr. Underwood, of Alabama, in replying, said it was absurd to claim that the reason that southern pig iron manufacturers were able to ship their labor abroad was because of the low price paid to labor in the south. He said the report of the labor commissioner showed that the average labor cost of a ton of pig iron in the north was $1.47 and in the south $1.52. It was true that the wages paid per day in the south was probably lower, as negro labor was employed, but the labor cost was higher. All of which goes to prove the correctness of former assertions made in these columns to the effect that the lowest paid labor is not always the cheapest labor.

Labor Making Machinery.

All machinery, in whatever form it is made must to secure a permanent introduction be labor-saving. A number of so-called improvements have failed of adoption, for no other reason than that the labor involved was greater with than without them; in other words, instead of being labor-savers they proved to be labor-makers. Curiously enough, the inventors of these contrivances have chosen to rail against the hostility of labor, instead of acknowledging the inferiority of their machines. The Trade Journals Review notices a case of this kind in a "New Hydraulic Pig Iron Breaker," made in Germany, of which it says:

"We have no intention of finding fault with the machine. It will break pig iron into pieces suitable for charging into the cupola perhaps as well as any other machine that might be devised, but will it save labor, or do the work more economically? We say most emphatically that it will not. A stout Irish laborer, with a simple sledge hammer, will break more pig iron lying on the ground, in an hour, than it is possible for a trained man to do by this machine in two hours. And we have no hesitation in saying that the labor of lifting each individual pig, wedging it in position, withdrawing the wedge, and pushing the rough bar through, involve far more arduous movements than swinging the sledge hammer."

After a while we may hear that this machine would be all right if it was not for the objections of the Irish!

Theory and Practice.

It has been our aim to confine THE FOUNDRY as much as possible to discussions of a practical nature, believing that such is what the average foundryman needs more than anything else. If we have erred in occasionally admitting to our columns questions bordering on the theoretical it is because the boundary line between theory and practice is, in foundry work, very indefinite. It is almost impossible to discuss any question relating to iron and its behavior without introducing theories. We know of no work on metallurgy which does not contain a number of these in order to explain the actions by which certain results are reached, nor do we see any reason why we should exclude all communications which fail to agree with our own ideas. We are not infallible, nor do we know it all, and there is a standing invitation in THE FOUNDRY for all who differ in opinion on any of the propositions made through its columns to advance individual theories. With a number of theories advanced we have always trusted to the intelligence of our readers to decide for themselves what part of each to accept. We may consent to act as judge and jury in some matters, but we acknowledge that no arbitrary ruling from us can affect the superior judgment of a majority of our readers.

We are prompted to say this by a criticism of the Engineering News, on a recent article in THE FOUNDRY. We are pleased at all times to be put upon the right track and to have any erroneous ideas eliminated, and shall gladly give space to any corrections our contemporaries may have to offer. Un-

fortunately while the journal named finds fault with a certain article it fails to leave us something better, which we might substitute for those theories it condemns. While it has left us with the impression that we are wrong some place it has forgotten to leave us any explanation of the theories advanced. We prefer something to an empty space, but shall be ready to change this whenever anything better appears.

Workmen and Laborers.

In an address made some time ago to the students of the University of Chicago Edward Everett Hale drew a distinction between work and labor, workmen and laborers, that is deserving of the widest publicity. It is only to be regretted that speeches of this kind are not delivered before bodies of industrial workers, where they would be of the utmost service in expelling the idea that the terms workmen and laborers are synonymous, when, in fact, they are opposed to each other. Mr. Hale defined a laborer as a drudge, who uses only his muscles without showing any interest in the result of his labors, as one who works only because compelled to in order to obtain the necessaries of life, as an animal does to preserve its existence.

A workman, on the other hand, not only uses his hands, but his head as well. He has an interest in what he produces, besides the pecuniary gain which it affords him.

That a workman thus becomes more desirable than a laborer is evident. We see in our foundries examples of men whose only thought is to do just enough to permit them of retaining their position, while others are pursuing an energetic course and are always thinking about something. That some encouragement should be given to the development of the latter class is plain. It is to be deplored that too often what is called a standard rate of pay prevents the recognition of individual merit. It is only by allowing the greatest expansion of efforts on the part of each individual and a graduating scale of pay that we can hope to make workmen to the fullest extent from the overcrowded ranks of laborers.

Krank's Korner.

The people of the United States take pride in making the claim to be the best informed nation on earth. And there is much to justify them in considering their general fund of knowledge above par when compared alongside of other nations. The large number of publications which they support are continually adding to their stock of information with the result that what we are pleased to call the world's news is readily chronicled and placed before them. The average citizen will think nothing of paying from five to ten dollars a year to maintain his intelligence, to keep posted on the world's progress. He will justly consider that this money is well spent and that he receives full value in return.

* * *

It is rather strange to compare the liberality with which the newspapers are treated with the attention the average mechanic bestows on his trade paper. If the former can secure him a fair return on an investment of ten dollars yearly how much greater must be the returns he receives from a quarter of that sum spent for his trade paper. Yet the cases are numerous where our mechanic will spend money freely to keep informed as to the trend of politics, while money spent for the trade paper will be looked upon as wasted, just as if it was used to settle a doctor's bill, with nothing to show for it.

* * *

We can only account for this condition of affairs by supposing that those who ignore their trade paper are more interested in something else besides their trade. If we follow them throughout their work we will find their hands engaged in one kind of work and their heads in another. About the best test an employer could make as to the attention his employes paid to their trade would be to secure the names of those who read their trade paper. It may be taken for granted that these are at least taking more interest in their work than those who do not. It may be that to many trade literature appears uninviting and that to obtain relaxation they seek solace in something more agreeable. But nothing ought to interest a mechanic as much as his own business and we can only reassert our opinion that those who refrain from finding out what progress is being made in their trade are not representatives of our best type of mechanics.

In order to aid the sale of some lines of machinery it is often claimed that it can be operated as well by a common laborer as by a skilled mechanic. It has been a fad with many engine builders to make this claim, which we were pleased to see badly upset a while ago by one of the journals devoted to steam engineering. The paper called attention to the absurdity of claiming that a common laborer could do as well as those having had years of training. Of course a common laborer might be educated to do the work, but then he would cease to be common, as that word is understood.

* * *

We note a recent claim made for a molding machine to the effect that it could be operated as well by this same common laborer as by a molder having a wider experience. Now in order to avoid subsequent disappointment to purchasers it may be well enough to state that there is no molding machine with which skilled labor is not able to obtain better results than a common laborer. No molding machine has yet been perfected from which the output may not be visibly affected for the better by being conducted by men capable of exercising some judgment between cause and effect. We do not deny that such machines can be operated at times by a common laborer, so can a typewriter or a locomotive, but there will always be a wide difference between the quality and quantity of what is produced by experienced hands and that which is turned out by the novice.

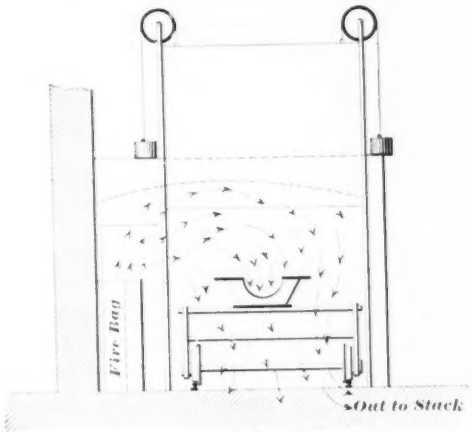
Down Draft Core Oven.

PART III.

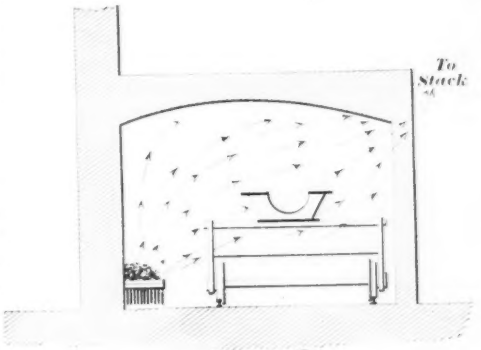
By W. L. HAYDEN.

(For Part I. see December, '96, Foundry. Part II. appeared in the March number.)

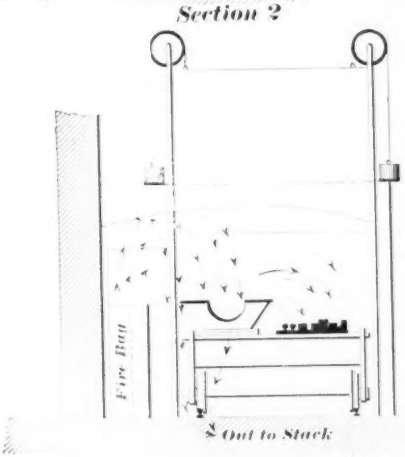
There are many details that could be taken up, in describing the points of a down draft core oven, but lack of time and space will allow the writer to dwell only upon the most prominent features. These features alone have made this style of core oven preferable to any other method of draft by those who operate them. The first place economy in fuel is an important item in itself, and from statistics I have gathered, and after careful comparative figuring, the following general results were obtained. After 295 days of firing with a constant heat, 24 hours in each day, the final results show that about 40 per cent less coke was consumed in our down draft than in our up draft oven of the same dimensions, all other things being equal. I account for the less consumption of coke in the down draft oven from the fact that hot air is retarded by the arch making a com-



Section 1



Section 2



Section 3

plete circle and a slower exit than the rapid circulation of the up draft style. In other words, the shortest distance between two points is a straight line. Then again the same air and gas passes the object to be dried at a great many angles, in this way a double benefit is derived, that in an up draft oven is impossible. Constant reflections seem to intensify the penetrating power of the heat generated, for I have particularly noticed that when both ovens have been heated to the same temperature, the down draft will give the required results in much less time than our up draft, all other conditions being equal. It might be well to bring out one great advantage that is gained by this new style of draft. To show it in a plain manner the writer has placed two sectional cuts, No. 1 and No. 2, in this article. The first represents the down draft oven with core oven car and the drag of an iron flask containing the half mold of a large vibrating spindle. The second represents the up draft oven with car and cope, the other half of mold of the spindle referred to. Following the arrows in Section 1, the reader can see how the heat arises from the fire bag to the arch, striking it at an acute angle and leaving it at different tangents in a downward direction. At this point you will see that the heat comes directly into all pockets of the mold without having to penetrate from the outside, as in Section 2 (up draft). Of course the general temperature of both ovens may be the same, but a better penetration and quicker results can be obtained when the current of air settles directly into all parts of the face of the mold drying. Another important feature that can be brought about in this oven is the concentration of heat in any one part of the oven. This is easily accomplished by removing the grates over the square flues and replacing them with solid plates, thus directing the whole force of draft to that part of the oven where the openings have been left. For instance, if we have on our car molds to dry or large cores situated on one side and the other side filled wi... small cores, the heat necessary to thoroughly dry, in the same length of time, would have to be much greater on one side than on the other. Removing the grates under the small cores and cutting off the circulation on that side, with the openings under the large articles, makes the current of air press this side alone, leaving the smaller cores to dry from the general heat that will expand in their direction. Section 3 explains this method. In the ordinary up draft oven the drying of molds is not always satisfactory from the fact that the heat strikes the outside on one side and the inside on the other, giving us a surface that is much harder on one side than on the other, often causing trouble at the time of pouring. The down draft method obviates this trouble, as the current of air descending in equal density directly upon the entire surface of mold makes that surface uniform throughout. Of course there are ovens on the market at the present time that for mechanical completeness are far superior to this oven, and again are very much more expensive to construct, but for practical results and uniformity of heat, this oven is hard to beat. Cores in a general foundry play an important part in its daily life, and when it is necessary to carry a great many stock cores on hand to meet the daily demands, the percentage of loss is greater in defective castings. The reason for this is, that a majority having laid around for several days become rotten and have not the strength to resist the flowing iron. We found this to be the case when using the old up draft oven. The length of time it took by this process to dry cores made it necessary to keep quite a stock on hand, but since we have adopted the new oven, the difference in time of drying is so much less that we are able, although running a greater tonnage per day, to carry a very small stock of standard cores, getting them fresh and materially decreasing the former loss. We have every facility here for natural gas, but after giving due consideration, I think that coke is the best fuel to use, although gas has many conveniences.

Although operating but a small foundry, I feel that the points and suggestions I receive from the perusal of my monthly visitor, THE FOUNDRY, is worth a great deal to me. Us foundrymen who run small shops never know what perplexing jobs may appear to tackle us at any time. With THE FOUNDRY we are prepared.

T. F. STIMPSON,
Hancock Foundry,
Hancock, N. Y.

Theories Pertaining to Iron and Steel Discussed.

By S. S. KNIGHT.

The results of the scientific and methodical investigation which has in the last ten years been applied with such signal success to the more difficult and abstruse problems of metallurgy, the development of the science of metallography, and the facts adduced therefrom, have no doubt been the means not only of solving many heretofore unexplained phenomena, but also of giving a great stimulus to work of this character, and hence of greatly augmenting the possibility of future discoveries.

In looking over the advancement which has been recently made, not forgetting that more real progress has been made in the last fifteen or twenty years than in all preceding time in iron metallurgical work; it is noticeable that by far the greater portion of the work has dealt directly with steel to the almost complete exclusion of cast iron. In the line of ordinary commercial steel work, the crucible has been superseded by the plain reverberatory furnace, this by the goose-necked furnace, and this, in turn, by the converter; and now the indications are favorable for the entire decline of this apparatus and the reinstatement of the furnace either of the acid or basic type. Solid fuels were succeeded by water gas; this by natural gas; and this, in turn, by producer gas. But in the field of cast iron the cupola is still used; the only essential modification being the central blast arrangement of the tuyeres and the use of steam in the blast. Together with these should possibly also be mentioned the use of small amounts of aluminum when used as an alloy with iron.

So far as the author is aware, his own was the first suggestion of the application of steam in the air blast of the cupola furnace. Long ago he began to search for some mode of reducing the oxides of iron in the cupola in place of dissolving them in a flux of the alkaline earths. At first the so-called spathite ore was used, but with very slight success. After this, salts of the alkalies were tried with a view to decompose at a low temperature and set or vitrify the slag coincidently with or before the melting of the metal; while some reducing gas was at the same time liberated. At last the idea of using the carbon in the cupola presented itself; and, aided by a knowledge of the reactions which take place in a Siemens producer in the manufacture of producer gas, and also of that which takes place in a furnace where water gas was being generated, it was but the next step to utilize carbonous oxide gas, since its reducing power is well known. The only logical methods which presented themselves to accomplish this were: First, by duplicating the manufacture of water gas either by injecting live steam in the tuyeres and thus bringing it directly into the presence of incandescent carbon, or to form the gas in a furnace and inject it into the cupola. To the latter method there were two serious objections; first, it was not economical, since it necessitated the establishment and maintenance of a water gas plant; and second, the water gas thus injected would unite with oxygen before it could possibly reach the melting metal, because the carbon monoxide was in the presence of free oxygen and all that was required for its combustion under these circumstances was a high temperature. This it would obtain in passing through the glowing fuel while the oxide upon which it was intended to act was already in the slag, and consequently completely protected from its action. For these sufficient reasons the second method only was deemed feasible.

With this the reactions were assumed to take place in the following manner: As the steam and air enter, the air partly burns the carbon, causing it to be incandescent, while the steam combines with part of the yet unburned carbon, forming carbon monoxide, and evolving still more heat.

$$C+2\ O=C\ O_2 \text{ and}$$
$$C+H_2\ O=C\ O+2\ H.$$

This free hydrogen recombines with oxygen from the air and is ready for a repetition of the process, while heat is still evolved with each new chemical change. $2\ H+O=H_2\ O$.

The carbon monoxide thus formed, if generated adjacent to the heated oxide, takes its oxygen from the oxide of iron or solid body, thus reducing the oxide of the metal before

the slag gets contiguous to it or absorbs it.

$Fe_2O_3 + 3CO = 2Fe + 3CO_2$.

In the ordinary process the only chance of reduction of the iron oxide is by the carbon reaction thus:

$Fe_2O_3 + 3C = 2Fe + 3CO$.

This reaction is hindered because the slag melts at a lower temperature than the metal, and the carbon is not everywhere in contact with the metal as a gas would be.

The free hydrogen should be considered, as its power of reduction is great. This being a gas, its action is greatly facilitated, and, no doubt, aids in the reduction of the ferric oxide as follows:

$Fe_2O_3 + 6H = 2Fe + 3H_2O$.

The saving occasioned by the use of this method would be of sufficient moment to establish its merit even if this were all. But the ameliorating effect upon the grain of the metal and its properties must not be overlooked. The effect of the presence of free hydrogen, the greatest of reducers, and also the much greater degree of heat possible to obtain gives this method much in its favor.

Such was the logic adopted. Frequent analyses of the escaping gas both when this method was used, and when not used, showed clearly the success of this process as well as the character of the metal itself, and it was with a somewhat pardonable feeling of satisfaction that the experiments, although relinquished for the time, were deemed a perfectly successful demonstration of the reasoning employed and of the results anticipated.

Concerning the previously mentioned metallic arrangement, a few observations may not be amiss. The power of reducing compounds on the crystalization of metallic substances has long been known, but the effects which accompany their presence were attributed to the degree of heat used rather than to them direct. But their action in most cases may be partly catylitic and partly direct, since the carbide of iron is broken up in some degree and free carbon or graphite formed, while silicon compounds are deoxidized, and this element thus added to the metal. This action or reaction may be modified or entirely produced by causes wholly unknown as yet. At least in the consideration of this point a few words on the phenomenal behavior of steel both when being heated and when cooling, should be added and any influences that are bearing on this point drawn. It has long been known that steel when being heated, and also iron, where total carbon exists in the combined state, is gradually and uniformly raised in temperature until a certain point in dull redness, when the rise entirely stops for an appreciable time, and then continues uniformly as before, the nearer the temperature of the steel approaches that of the flame the more slowly does the temperature of the steel rise. On cooling, the reverse phenomenon is observed, the temperature falling regularly, until the point in redness is again reached, when the metal instead of further cooling, rises to a glow and then uniformly subsides. This point of recalescence is called by Brinnell the W retardation point in heating, and the V retardation point in cooling. Other retardations also occur at higher temperatures, but it will not be necessary for our present purpose to enumerate them, therefore they are omitted from consideration. Many theories concerning the causes of this so-called Gore's phenomenon have been formed, all looking forward to an explanation, two of which will be considered, since they have more in their favor than the others, and because they are better known.

The first assumes that iron can exist in two different states; in other words, that it is allotropic, the same as carbon, sulphur, and phosphorus are. In the (A) or normal state its properties are those familiar to this metal, while in the (B) state it is extremely hard. It is well known that steel when quenched or suddenly cooled from a high temperature is hard and brittle, and that when slowly cooled is soft and ductile. Then according to Osmond, the author of this theory, the metal which when cold is in the (A) state, when heated beyond the W point becomes iron in the (B) state, and since some time must elapse in order for the change from the (B) to the (A) state to take place; the sudden cooling does not give sufficient time, and hence some of the metal exists in the hypothetical (B) state, which accounts for its hardness. This theory is a pure supposition which, from its very nature, never can have any positive evidence in its favor, since it would be impossible to dis-

tinguish by chemical means between the iron in the (A) state and that in the (B) state, since in the identification of allotropic forms the vapor density is the determining factor. But iron long before it passed into vapor would by the hypothesis exist only in the (B) state. So much, then, for Osmond's theory.

Before considering the next theory, it should be known that in a quenched or quickly cooled steel, the degree of hardness is roughly proportioned to the total amount of combined carbon present in the steel, and it was thought, but not positively known, that the combined carbon in quenched steel, known as hardening carbon, was of different composition from the cement carbon (combined) that existed in slowly cooled steel. This fact Osmond harmonized with his theory by supposing that the change from one state to the other was interfered with or clogged by carbon. Mr. Howe holds that it is the change of the carbon from the cement to the hardening state that produces the phenomenon in question. He attempted to show by the method of determining combined carbon by solution in nitric acid, that the position held by him was correct. But it should be remembered that so far as the Eggertz color method is concerned, that no distinction can be made by it between one form of combined carbon and another. In fact, no method has as yet been given the world by which it is possible to quantitatively distinguish between cement and hardening carbon. This fact is made by Mr. Blair particularly conspicuous in his elaboration of the above method. A short quotation shows in what state Mr. Howe withdraws from the field after attacking Osmond's hypothesis. "It is not to be supposed that the condition of carbon, if as I believe it to be, the chief, is therefore the sole element which determines the hardness and ductility." Summed up the case stands: both theories are purely hypothetical and formed from hypothetical factors, neither can be substantiated by direct evidence yet, and possibly never can. Nevertheless the fact of the phenomenon remains.

Coming back to the reducing compound and its action on iron. If the heat produced by the combustion of carbon monoxide is less than that produced by the burning of carbon, but yet hot enough to fuse the iron, it may be since the W retardation point is so low (between 640° and 655° Centigrade) that the gas in contact with the iron so reduces the attraction of its particles more or less permanently, that the causes of its peculiar crystalization are modified, and a more open fracture and softer metal result, which may in part be due either to the presence of all the metal in the (A) state or all of the combined carbon in the cement form. This, of course, is purely hypothetical, since no action of a kind similar to that in Gore's phenomenon has ever been known to take place in any iron containing free carbon, but this fact in itself helps to support Osmond's theory. In connection with the crystalization of the iron and the names of Osmond and Howe, it might be of interest to know that the exponents of the two theories just reviewed are prosecuting their investigations with the microscope, and have carried the science of metallography far beyond its past confines in order to substantiate the theories here set forth. The iron constituent itself is divided into three fundamental classes, not according to composition, but rather from a crystallogical standpoint. The first kind is called ferrite, which may be seen almost pure in malleable iron. It possesses one striking peculiarity, it crystalizes at a very high temperature, and then again at a lower one. The latter is its more stable form, and is undoubtedly formed by the freeing of a part of the carbon from the combination in which it existed. This is now largely done by mixing the cast metal with steel borings, which have been previously treated with hydrochloric acid and exposing them sealed from the air to a moderate heat and slowly cooling the metal off. Assuming the formula of carbide of iron under these circumstances to be $Fe\ C_2$, the liberation of carbon would take place as follows:

$$2\ Fe\ C_2 + 4\ Fe\ Cl_3 = 4C + 6\ Fe\ Cl_2.$$

This is the ordinary process of annealing as used in malleable iron works. The recent experiments of Dr. Harrison and Mr. Outerbridge have shown that ferrite may be produced in some degree by a simple jar, and the author's experiments have been corroboratory. The amount of ferrite formed, however, is limited and probably the increased strength is more due to the formation of this than to the relief of internal cooling strains, although the latter constitute no doubt a factor of some importance.

The second variety is known as pearlyte, and is supposed to consist of conformable lamellae or leaves. These are supposed to be composed of groups of two lamallae, one of iron and one of iron carbide. Osmond believes this latter to have the formula Fe_3C, but any evidence pointing to the correctness of this supposition has never been shown to the author. No known carbide has such a formula or anything analogous to it. If calcium carbide be treated with water or hydrochloric acid, acetylene is formed as shown in the equations:

$$Ca\,C_2 + 2\,H_2O = H_2C_2 + Ca(OH)_2 \text{ or}$$
$$Ca\,C_2 + 2\,HCl = H_2C_2 + CaCl_2.$$

These reactions are known to take place. If hydrochloric acid be added to iron borings in some such manner as is used in the determination of sulphide-sulphur with hydrochloric acid and sodium hydroxide or an alkaline solution of lead nitrate as recommended by Fresenions or Blair, the odor of acetylene may be recognized and its presence demonstrated. An apparatus may be constructed by which the acetylene may be eliminated and thus determined, since it is soluble in an ammoniacal solution of cuprous chloride. The hydrogen sulphide may be previously eliminated by passing the gas formed by the action of diluted hydrochloric acid upon the iron through a solution of silver nitrate. Great care should be taken, as the copper compound is quite explosive. The copper compound is now treated with hydrochloric acid, and the gas formed passed through a platinum combination tube nearly filled with copper gauze and oxide wire, while a constant current of pure oxygen is passed through it.

The acetylene is here burned and the amount of it may be calculated from the amount of carbon dioxide formed, which is easily absorbed in the potassium over calcium chloride. In this process too much precaution cannot be used as the mixture of acetylene and oxygen is explosive. Leaving out the copper compound, which is only a convenience and not a necessity in the process, the reactions read.

$$FeC_2 + 2\,HCl \times H_2C_2 + FeCl_2.$$
$$H_2C_2 + 5\,O = H_2O + 2\,CO_2.$$

Care should be taken to use only irons free from titanium and manganese, especially the latter, since the attempt to determine the amount of manganese combined with carbon leads to complications, which greatly diminish the approximate correctness of the results. The titanic carbide may be indirectly estimated with some accuracy, but this cannot be said of the manganese carbide.

The iron combined with the carbon may be determined with approximate correctness, since its isolation in its original state may be accomplished.

The combined carbon thus determined is found to be nearly the same amount as that determined by any standard method, and goes to prove the correctness of the formula FeC_2 as opposed to Fe_3C.

It seems strange that Messrs. Osmond and Howe, who bewail the fact that so many theories are given to the world on such slight evidence, should not have applied some test in order to determine the probable formula of iron carbide.

The third variety is known as cementite, and is a constituent of the hardest cast steels. It is also supposed to be a carbide of iron, but as to whether it is a fixed compound of definite composition, or whether it consists of carbon mixed with the hypothetical allotropic modification of iron is not known. It is supposed to be one of the largest factors in ordinary white pig metal, and may or may not be, according to Osmond, identical with the hard lamallae of pearlite.

The importance of the structure of iron or steel is well known, and some idea may be formed of how this structure is determined from the fundamental facts of iron metallography as here described. The influence of hammering, annealing, drawing and other treatment may be studied, and these effects positively made known. There seem to be other things beside the processes here enumerated that are capable of affecting the character of iron or steel in some unaccountable way.

Take, for instance, the product known as Bessemer steel, and consider how its properties are given to it. Since the discovery of argon, some scientists have suggested that possibly its properties were due either in part or entirely to the particles of this gas imprisonment between the particles of steel.

The chemical conduct of argon gave some reason for their supposition, since it would

not combine with any known substance nor was it acted upon by the most powerful oxidizing or reducing agents nor fusing caustic alkalies. This assumption is, however, purely inferential and unwarranted, since the very inertness of this element will prohibit any efforts to investigate its truth.

While considering the subject of crystallography or iron metallography, a few observations on the effect of various forms of crystalization might be apropos.

It has long been thought that the "grain" of cast iron was in some way accountable for its strength and generally speaking, the closer the grain the greater the strength. This theory is only partly true and should have been modified by stating that would be the case with an iron of constant composition.

It has been shown in a previous paper how this may be, since combined carbon, sulphur and phosphorus (when the latter exists in a quantity much exceeding 5 per cent) will both produce a close fracture and decrease the strength of the metal. The presence of the last two elements may be detected by observing the form of the crystals, and their relative position to each other.

Sulphur gives close iron a dark non-crystaline appearance, and in the pig is usually accompanied by indications of high shrinkage and blow holes. Phosphorus, on the other hand, gives the iron a greasy, flat-grained appearance, with a tendency to close crystalization.

The polyhedra are also usually truncated near the apex; generally the angle of truncation formed by the base and the cutting plane increases in inverse proportion to the amount of phosphorus the iron carries. As viewed by the microscope with sub-stage illumination, the lower phosphorus irons will reflect the light around the particles, and thus tend to form a ring of brilliance near the edge, produced by the inclined surfaces reflecting the light. On the other hand with high phosphorus irons, the planes of truncation are too near parallel with the base for this phenomenon to be produced.

This test is, of course, not conclusive since other causes may produce like results. Concerning the relation of closeness to strength, Mr. Keep says in a paper presented before the June meeting (1895) of the American Society of Mechanical Engineers: "If the grain is coarse and loosely formed, as in large castings, weakness will result from lack of cohesion. If the grain be fine and close, as in gray castings, they will be strong." In support of the statement, he gives the results of nineteen series of tests, but it seems after all as if he had reckoned without his host, for the fundamental matter of composition is, after all, one of the major factors in producing strength. The theory of the closeness of the grain being proportionate to the strength is, no doubt, well founded, it following directly from the law of gravitative attraction, which is the cause of cohesion. But the fact of composition must not be overlooked. Physically weak components produce a tendency to corresponding weakness in the metal, regardless of what other factors enter into the problem. The opposite statement is likewise pertinent and it affords the author some gratification, after the statements he has made concerning the influence of small quantities of titanium carbide, to see the statement made by such an authority as Mr. Youmans that the titanic carbide now made in an electric furnace is of enormous strength, and hard enough to scratch a standard diamond with ease.

It has been claimed that lack of silicon produced close grain and high shrinkage.

This statement seems, upon investigation, to need some modification. Below are given the analyses of two irons; the first (No. 1) very open and strong, possessing a regular No. 2 soft fracture, and the last (No. 2) close and very weak.

No. 1.		No. 2.	
Silicon	.489%	Silicon	4.184%
Sulphur	.014%	Sulphur	.025%
Phosphorus	.030%	Phosphorus	.860%
Manganese	.643%	Manganese	.518%
Com. Carbon	.486%	Comb. Carbon	1.172%

These analyses may also be compared to test the validity of the theory that combined carbon is due to lack of silicon. The weakness of No. 2 may have been produced by the high phosphorus and combined carbon, but this latter substance was certainly not produced by a lack of silicon. The strength of No. 1 could not have been due to close grain for this was lacking, but was undoubtedly produced by the low sulphur, phosphorus, and combined carbon, or those

constituents which are, in their combinations with iron, physically weak.

Let us return again to crystalization. If it be conceded that atoms are vortex rings of ether and that their rates of vibration are proportional to their absolute temperature, then although we can not as yet determine the causes of crystalization, we may form some idea as to how this phenomenon is accomplished. The atoms or molecules have fields, both individual and compound, just as a collection of magnets has. The stress, produced by these atom-magnets, forces the other atoms which come into their field to assume definite positions, just as iron filings do when in the magnetic field.

One fact that would seem to support this theory is, that at a temperature of moderate redness all sensible magnetism ceases, so whatever crystalization could exist above that would be passive in form. This is found to be in most instances the case.

This, of course, is purely a speculation and has only the virtue of being one way (and possibly the most simple and feasible one) of bringing to the human mind, those conditions by which such phenomena become possible.

Generation and Explosion of Inflammable Gases in Pouring Molds.

By THOMAS D. WEST.

In a further continuation of my reply to Mr. R. G. Moore's criticism on "American Foundry Practice," the next point to be discussed is that of the generation and explosion of inflammable gases, in which Mr. Moore claims he is not in accord with what appears on pages 57 and 58, and says, "It is better practice not to light such vent pipes to avoid explosions until all the atmosphere has been driven out by the gas, when it becomes safe from explosion."

The criticisms I have on the manner in which Mr. Moore has handled the question at issue lies, first, in his claiming that the atmosphere can all be driven off or, in other words, separated from the inflammable or newly generated gases to avoid injury; and second, in his leading all to think that the practice that he had advanced would cover all forms of lighting or "drawing vents." Before starting into a discussion of the subject of this article, I will state, that by referring to page 152 of the same work criticised by Mr. Moore, another condition of venting will be found in which it is often essential to "fire the vents" before the pouring commences, and in which if we followed Mr. Moore's advice, castings, as well as lives, would often be lost. As this is a subject very important to be understood, we will now proceed to discuss the composition of gases, principles involved in explosions; also, if it is practical to wait until all the atmosphere is driven off before lighting vents, after which then show in what manner different forms of molds are best vented, as far as this article will permit.

The air we breathe, or that confined within a mold, is composed of 4-5 nitrogen, 1-5 oxygen and about 4 volumes of carbonic acid in 10,000 parts of air. This proportion of carbonic acid gas can be increased in air by the confinement of people in a closed room or from carbonic matter undergoing decay for the reason air is not a chemical compound, but a mechanical mixture that unites readily with almost any proportion of gases or odors and can form dangerous compounds of a character known as "fire damp," which is explosive and "choke damp," which is suffocating and can extinguish life. As carbonic acid gas plays a part in explosions, as will be seen further on, we dwell a little at this point to treat more of its creation. It is well known that the oxygen of the air is that element chief in supporting human life or combustion of fuel. Oxygen gas enlivens us, and were it to become more excessive than found in air, we would become so active as to soon wear out or exhaust our lives. Carbonic acid can be said to bear the same relation to vegetable life that oxygen does to animal life. The leaf of the tree or plant is the lungs which take in air to extract from it that which imparts life to their growth and existence. The difference between animal and vegetable life lies in the former expelling the carbon of the air, while the latter retains it, thus causing vegetable matter to contain carbon to a greater or less degree. No trade has much more to do with vegetable matter in its relation to carbon than the founders, as most everything he handles contains it, and which is driven off by heat as carbonic oxides or acid gases to mix with air to assist hydrogen in producing inflammable and explosive compounds.

It will be observed the last sentence states that the carbonic gases assist hydrogen in

making atmospheric air explosive, and hence naturally leads us to the inquiry of where the hydrogen comes from. Hydrogen is derived from any water, moisture or dampness that may exist in the materials forming the mold. No one gas is of the same density as air. With air as 1, carbonic acid has a density of 1.5290, oxygen 1.1056, nitrogen 0.9713, and hydrogen 0.0692. By these gravities, we find that carbonic acid is the heaviest and hydrogen the lightest gas. The lighter the gas, the more quickly will it diffuse or separate from its mechanical mixture with other gases. Union of gases can be disturbed by changes from low to high temperatures in the body, containing them and the heaviest gas, when forcibly liberated, may settle to the bottom while the lightest may ascend to the top. Although air is surprisingly uniform in its composition the world over, it can unite with and absorb most any excesses of its own or foreign gases that may come to it from any source. Gases mix similar as liquids, and in combination they may do one thing that when separated would cause an opposite effect. As an illustration, water, which is composed of two volumns or measures of hydrogen and one of oxygen or by weight as 88.9 parts of oxygen to 11.1 of hydrogen, can, as long as these elements are combined, distinguish fire, but let these gases be separated, they can then burn or assist combustion. This fact is exhibited at every "bottom drop," or can be seen by throwing a pail of water into a large body of incandescent fuel. The high temperature of the hot coals or fire decomposes or separates the hydrogen and oxygen of the water, permitting the former to burn with a pale bluish flame, while the oxygen is absorbed by the fuel to incite temporarily its combustion.

Knowing, as we can, from the above analysis of this subject that there is reason to expect air to be incensed with an excess of carbonic acid and hydrogen gas, when pouring molds, it follows next to illustrate in what manner these excesses of gases are created, what effect they have, and how best to handle them in showing whether or not we should light vents in order to avoid explosions until all the atmosphere is driven out by the gas, as stated by Mr. Moore.

Before proceeding further with this intensely interesting subject, I would invite those who are interested in the subject, to ask themselves: Can all the atmosphere or its air be separated from the gases expelled by heat, from the materials forming a mold? A study of the foregoing part of this article would show such to not be the case. The manner in which Mr. Moore has put his statement would assert that air and foreign gases do not mix, and that when a mold is poured, we first drive out all the pure air, and then the gases expelled from the material forming the mold takes its place, as if they were compounds of oil and water.

No, Mr. Moore is wrong in his hypothesis. The action of the gases in pouring a mold is simply one of diffusion, and according to the compounds created, just so are they made explosive. No one gas is in itself explosive. It requires a compound of gases to produce explosions in molds. The gases chiefly responsible for explosions, when mixed with atmospheric air, are hydrogen and carbonic oxide or acid gases. When two volumes of hydrogen are evolved from the mold to mix with five of its confined air, a spark or high heat will make the compound explosive, and again the hydrogen mixing with the carbon can generate inflammable gases, which, when combined with the atmosphere, will create an explosive compound. Now the main question with the molder or founder is, how to take off these inflammable gases without causing an explosion, and, before starting a discussion of this quality, I would first say that conditions as to the form and character of a mold demand different practice, and that it would not do to class them all under the same one practice, as advised by our brother craftsman, Mr. Moore.

There are many practices in founding that we learn by experience must be followed, to avoid disastrous results, among which are plans that must vary in the lighting or "drawing of vents." A few may understand the principles involved, and thus be enabled to work intelligently, but those that do not are very apt to be led some time or other to certain practices that insure safety by reason of sad experience. The writer being no exception to this rule, as long before he came to study cause and effect in founding, he went through an experience in lighting vents which he never can forget, and as the same will be of value here to demonstrate the disaster that can result from following the plan advised by our friend Mr. Moore, we will cite it. A few

months after I first entered my apprenticeship, under my stepfather, Andrew Baird, at the Portland Locomotive Company Works, Portland, Me., about 1861, I was instructed by my father to light some shavings placed in the bottom of a wooden vent box that was about 18 inches square, leading down to a "cinder bed" about five feet below floor or joint line of the green sand mold. Special advice was given me to be sure to set fire to the shavings, when he gave me the words "light the vent." The casting was a very heavy one, full of all kinds of cores, and two large crane ladles were used for pouring the mold. It was a new experience for me to be an assistant in the pouring of a large casting, and boy-like got my attention diverted in the excitement of the occasion to such an extent as to lay down a long rod, given me to reach the shavings, which I was

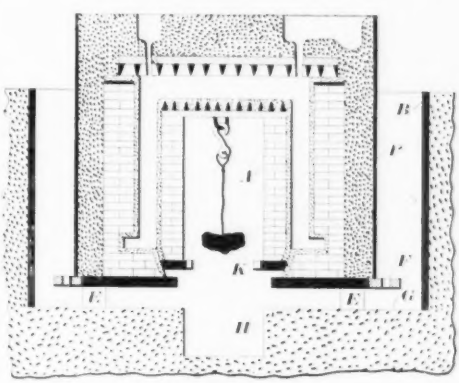


Fig. 1

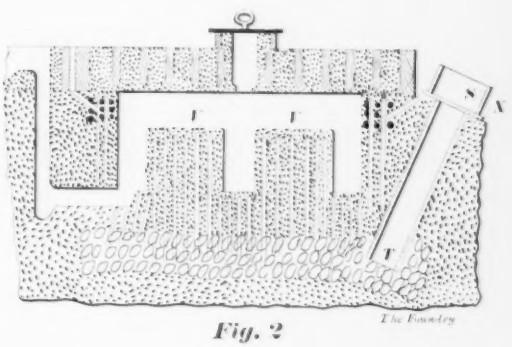


Fig. 2

supposed to heat in the ladle of iron. When the time arrived for me to use Mr. Long Rod, I could not find it, and as my father yelled out "light the vent," I picked up the first short rod I could lay my hands on, placed it into one of the crane ladles, got it hot, and then stuck my head and body down into Mr. Vent Box, so as to reach the shavings to set them afire. For a period I was dead to the world. When I regained consciousness, I found myself several feet from the mouth of the vent box, and saw my father standing in the midst of a lot of flask weights, surrounded by smoke and gas flames, shouting in a very pitched voice for water. Realizing the great danger he (my father) was in, I summoned sufficient strength, although half blind, and grabbed a pail, ran to the water tub; upon returning fell into one of the crane ladle holes, knocking my burnt skin from its flesh. Feeling extremely sore, and that there was no place like home, I quietly made my exit, unnoticed. My father was at a loss at my disappearance, and after looking in the vent box and through the shop, he then went home to see if I was there. I was there, hairless, and my face, arms and neck covered with molasses and flour, a sweet flouery looking duck. The three weeks' reflection which my condition permitted, led me to do some serious thinking, and neither Mr. Moore nor any other person could get me to wait until the atmosphere had been driven off before I lighted the vents, if such molds were at all necessary to be "fired" at any time during a pouring.

The above is one illustration of the necessity to "fire the vent" before pouring commences; and another is demonstrated at the present time by making ingot molds, which are cast with a hollow core barrel, that if not fired just as the pouring commences, will nine times out of ten explode, so as to burst the core, and thus ruin the casting.

A third illustration is shown by the cut Fig. 1. Here is a casting that compels the retaining of a large space, wherein a big volume of air or gas can be confined, which, if permitted to remain unignited, after the point is attained which would allow of their being fired, there is then great danger of the heat being generated from the mold, or sparks setting fire to the accumulated gases further along in the pouring at a time when their concussion would be injurious; something on the plan of a little powder, a little explosion; lots of powder, a big explosion.

Large spaces for the confinement of gas is similar to large bores in guns. They provide the larger area for the storage of explosives. Some experienced molders, whenever practical, would fill such an air space as A, Fig. 1, with dry sand or very fine coke, and then let the gas take care of itself, but, of course, there are very many instances that such cannot be done, and then in all such cases the largest outlet should be provided for the liberation and expansion of inflammable or explosive gases. The mold as shown in Fig. 1 is supposed to be a kettle or cylinder, with the bottom cast up, poured in a pit, having a curbing around the mold, as seen at B; should such a mold not be rested on several bearing blocks, as at E E, so as to leave a free air passage almost wholly around the mold, between its bottom plate F and the ground G; then a large channel as at H is often best formed, which will permit a man to enter and light a bundle of oil waste or shavings, as seen at K, before pouring is started, as in all such cases where there is any possibility of large bodies of gas being confined, a fire should be started before the pouring commences, though it is contrary to the advice advanced by Mr. Moore, but which I believe, as far as I have carried the reader, will show my philosophy to be correct, and one safe to practice for such character of molds. It may be well to state that too large a fire should be avoided, and that it is well to suspend all such fire wands for "lighting vents." Upon the plan seen at K, as by this it is taken off the ground to the greater insure its continuing to burn after being lighted, and not be extinguished at the first creation of "dead gases," but will remain light to set them afire at their earliest approach to being sensitive to ignition. Having shown conditions that make it wise to "light vent" before pouring commences, I will now show those that are often best to have a "cold vent," or not to be lighted until a mold is partially or wholly filled, and which is displayed at Fig. 2. This is a class of work which can often well have its vent outlet smothered with a bunch of wet hay or piece of carpet, as suggested by Mr. Moore, and the trick is a plan which can be improved by the insertion of a piece of fine wire gauze over the mouth of a pipe, as illustrated at X, Fig. 2, which admit of placing oiled waste or shavings in a box, S to give draft and set afire inflammable gases when they reach the atmosphere, and not before, thus preventing their taking fire at T, at the bottom of the "cinder bed," which might cause a slight explosion or sudden expansion of the gases to take place, to thus drive them up through vent holes, and lift, start or scab the face of projections at such parts as V V, before the rising metal had reached a height to well cover them.

With conditions that call for a large area of mold surface, being covered at the first of a pouring to suddenly evolve a large volume of inflammable gases, it is often well to then have shavings at the bottom of a vent exit to be fired when the pouring commences, to ignite and create a quick draft to carry off the accumulating gases, but as a rule, when such is figured for, the area for the vent outlet should be large, so as to allow good room for the sudden expansion of the gases to find quick relief of their pressure up through the vent outlet, instead of endeavoring to escape up through the mold's vent holes. However, it is to be remembered that cuts Figs. 1 and 2 illustrate two distinct conditions to be found in general founding, Fig. 1, illustrates form as herein outlined, that must be closely and carefully followed, whereas with Fig. 2 vents may in many cases be fired before starting to pour a mold, and then again often it admits of a go-as-you-please practice, and no serious injury comes from it, but in either event a knowledge of the principle involved in the generation and explosion of inflammable gases cannot but be of the greatest assistance in guiding a molder what practice to follow to obtain the best results, with the varying conditions one may meet in general founding. As this subject has occupied so much space, I shall let this and the last two journals suffice for my answer to Mr. Moore's criticism, and shall be pleased to hear from him in reply if he continues to believe the points he criticised are still in error.

THE FOUNDRY fills a long-felt want. May your days be long and prosperous.

J. L. NIX,
Prairie State Incubator Co.,
Homer City, Ind.

Contraction and Deformation of Iron Castings in Cooling, From the Fluid to the Solid State.

By FRANCIS SCHUMANN.

One of the most serious and annoying difficulties to the iron founder is the tendency of castings to deformation, due to unequal cooling and consequent unequal contraction, excessive initial stresses, if not cracked castings, often resulting, no matter how carefully molded or with what care the iron is selected and manipulated.

Our knowledge as to the causes has been but vague, notwithstanding the thought and attention given the subject.

The writer, impressed with the importance of the matter, and having opportunities for observation and experiment through his connection with foundries where great diversity in the form of product resulted, decided to investigate with a view of discovering what laws of physics applied and in how far the cause and effect were determinable and controllable.

After some twelve years of observation and research the writer is enabled to submit the result of his labors, which it is hoped will prove of practical use to the engineer and foundryman.

Cast iron, as well as all other bodies, with but few exceptions, expands or contracts equally in all directions, with the increase or decrease of its temperature, respectively. Hence the proportions of a body, whether its temperature increases or decreases, remain alike. At moderate low temperatures, from 32 degrees to 212 degrees Fahr., the change is directly as the temperature. At high temperatures the changes are greater than the changes in heat.

Contraction takes place just when incandescence disappears, or when the color changes from red to black, and continues until the temperature is normal to that of the surrounding mediums.

A prism cast in a sand mold will maintain its alignent, after cooling in the mold, provided all parts around its center of gravity of cross section cool at the same rate as to time and temperature.

Deformation is due to unequal contraction of the elements of the cross section surrounding the center of gravity of the section.

Unequal contraction is due to unequal cooling, causing, or tending to cause, initial stresses in the elements of the prism, resulting in deformation or rupture.

The rate of contraction between the fluid (heated) state and the solid (cool) decreases with the volume or mass of the casting, and inversely as to time of cooling.

Rapid cooling tends to increase the density of the iron; the crystals are diminished in size, and the fracture denotes greater compactness, with more evenness of surface and less ruggedness. The color tends towards white, denoting a change of carbon into the combined state at the moment of solidification. The size of crystals decreases with an increase in combined carbon. Its resistance to impact is lessened, and the rate of contraction is increased.

Slow cooling develops larger crystals, less density, and increased ductility. The fracture is darker or more gray in color, the surface uneven and rugged, and the carbon is in a more free state. The contraction is lessened, and the casting has greater resistance to shock, although its resistance to a quiescent cross-breaking force may be less.

In any prism, variations in density may occur by reason of differences in the rate of cooling, the more rapidly cooling part being more dense, made so by the molecules drawn from the still fluid part of the casting which, cooling later, will be less dense or with a diminished number of molecules. The molecules in adjusting themselves follow and flow in lines coinciding in direction with the waves of cooling, being from a high to a lower temperature, thus tending to create a void and lessening the density of those parts which cool slower.

The rate of cooling, or dissipation of heat, is uniform around the perimeter of the cross section.

The total amount of heat to be dissipated per unit of perimeter of section may or may not be uniform or equal, depending upon the character of the cross section.

The greater the amount of heat to be dissipated per unit of perimeter the slowgr the cooling

A plane of neutral or mean action, relative to the total dissipation of heat, passes

*Abstracted from a paper read before the American Society of Mechanical Engineers, at the New York meeting (Dec., 1896.).

through the center of gravity of the cross section. In symmetrical sections the action is alike on either side of the neutral plane, while in unsymmetrical sections it will, or may, vary.

The dissipation of heat through the perimeter of a section follows wave lines perpendicular, in direction, to the perimeter.

The amount of heat to be dissipated per unit of perimeter varies in proportion to the volume or mass of the prism of which the respective unit forms the dissipating side.

The relative amount of heat dissipated in a prism, per unit of time, varies in proportion to the dissipating surface of the perimeter divided by its respective volume of cross section.

The crystals that form in cast iron, when changing from the liquid to the solid state, have the tendency, when no disturbing causes interfere, to form themselves into regular octahedrons, or double four-sided pyramids, with their bases joined.

Their size varies, the mean increasing with the slowness of cooling. The long axis of the crystals tends to adjust itself perpendicular to the plane of cooling surface of the casting. Thus, in a cylinder the axis would coincide with the radial lines, while in a square prism, the axis of the crystals being perpendicular to the four sides, will tend to flow apart on a plane bisecting the angle of two sides; on this bisecting plane the casting will be less dense and of diminished cohesion.

A prism, unsymmetrical in section, in which the proportion of cooling surface varies around the center of gravity of the cross section, will have the greatest proportion of smaller crystals in the parts cooling the quickest. Where the change in the rate of cooling is greatest will be the place of greatest interference to the natural adjustment of the crystals, as to size and position, and hence the place of least cohesion.

Contraction is in a direct relation to the rate of cooling and size of crystals. The more rapid the cooling the smaller the crystals and the greater the contraction.

In any prism, unsymmetrical in section, composed of a smaller mass joined to a larger, the greatest longitudinal contraction will occur in the larger mass. This apparent contradiction to the general law, that contraction decreases with the mass and rate of cooling, is explained when we consider volumnar contraction. The larger mass will have its rate of contraction equal in all directions; the smaller mass is restricted in its contraction longitudinally by the larger mass at the joint of juncture of the two masses, but maintains its greater rate of contraction transversely; were the transverse rate the same as that of the larger mass, its longitudinal contraction would be the same, but its transverse rate being greater, the excess in volume flows in direction of length, resulting in a greater length, after cooling, of the smaller mass.

When the rate of contraction in the elements of the cross section of a prism are known, the resulting change in alignment and initial stresses, due to the differences in contraction, can be determined.

The line of mean contraction passes through the center of gravity, or neutral plane, of the cross section.

In unsymmetrical sections the center of action of the maximum and minimum contraction coincides with the center of gravity of the area elements that are separated by the neutral plane which passes through the center of gravity of the whole section.

Modifying causes that affect the results obtained by the application of the preceding laws are: Imperfect alloying of two or more different irons having different rates of contraction; variations in the thickness of sand forming the mold, which is the medium for conducting the heat from the surface or perimeter of the cross section; when the prism is cast in a horizontal position, and thin layers of sand at top and bottom affect the dissipation of heat, which becomes unequal by reason of the difference in circulation of air between the upper and under external surfaces of the mold, the upper surface dissipating the greater amount of heat; the position and form of cores, which tend to resist the action of contraction, also the difference in the conducting power between moist sand and dry-baked cores; differences in the degree of moisture of the sand surrounding the prism, especially when small in mass; unequal exposure by the removal of the sand while yet in the act of contracting; flanges, ribs, or gussets that project from the side of the prism, of sufficient area to cause the sand to act as a buttress, and thus prevent the natural longitudinal adjustment due to contraction; in light castings of sufficient length

the unyielding sand between the flanges, etc., may cause rupture.

Carbon is the most active element, when in the combined state, to increase the rate of contraction. As strength and hardness result from slight increase in the proportion of combined carbon to that in a free state, it follows that strong irons have a greater rate of contraction than those in which a lesser amount is present. When the combined carbon exceeds certain limits, hardness and contraction increase rapidly and the strength decreases. Increase in the proportion of free carbon has the opposite tendency.

Silicon, when present, not exceeding certain limits, tends to free the carbon, reduces the rate of contraction, and increases the ductility and softness of the iron. Increasing the silicon up to, say ten per cent., causes the iron to become brittle, hard, and weak, and increases contraction.

Sulphur tends to change the carbon into the combined states, and hence increases the rate of contraction.

Phosphorus, while tending to harden the iron, has little, if any, influence upon the proportion of combined to free carbon. It lessens the rate of contraction and diminishes the strength of the iron.

Manganese, as usually present in foundry irons, about 1 per cent. has no appreciable effect. When, however, it reaches 1.5 per cent., and the iron is low in silicon, it tends to hardness and increased contraction, although no alteration in the carbon is effected. In some hard irons the combined carbon is lessened, as also the contraction, by adding small quantities of not exceeding 0.15 per cent. of manganese to the molten iron in the ladles just before pouring in the mold. Increased strength also results.

Repeated remelting increases the rate of contraction; it tends to harden the iron and increases its density. Originally soft mixtures become stronger and harder, while hard mixtures become harder; the proportion of free carbon decreases and the combined increases; the total carbon is slightly decreased. Silicon and manganese rapidly decrease, phosphorus to a less extent, while sulphur rapidly increases, due to the fuel.

At this point Mr. Schumann, who by the way, has had one of the most extensive experiences in practical foundry affairs, presents some algebraic formulas, supplemented with illustrations of objects treated. The whole shows the great amount of thought the writer has bestowed on this subject, which has yielded fruitful results, as evidenced by the following conclusions:

The deformation of prisms due to unequal contraction can be overcome by providing counter deformation in the pattern, or by the addition of auxiliary parts that can be readily removed from the casting. Generally, the section should be so subdivided or designed that the ratios are alike around the center of gravity of the section.

In complex machinery castings the design should be so modified or chosen that these will result in the least differences in the rate of cooling, or ratios of the different members. Sudden changes in form cause severe initial stresses, if not fracture, and should be rigidly avoided.

Imperfectly proportioned flanges, ribs, or gussets added to the main body of a casting, for either the purpose of increasing the strength or connections, may be sources of weakness.

Hollow cylindrical columns, although cast of even thickness and left in the mould until cold, may become crooked by reason of the unequal rate of cooling between the upper and lower halves, due to the currents of air passing through the column and clinging to the under side of the upper half after the core arbor is removed, which is usually done shortly after pouring and while the casting is still red hot. This deformation is avoided by stopping the ends with sand immediately after the withdrawal of the core.

Greater attention to the laws of cooling and correct forms and proportions of castings will result in increased strength and economy, besides the avoidance of annoying crooked castings and mysterious breakdowns.

Tubal's Meditations.

A shaky flask is like a touchy woman, the more tenderly you handle her the less danger there is of a fall-out.

Gaggers are little things; so are words, yet they carry a load of responsibility.

The man who permits a boy to make a job wrong, when he knows it, would lick his wife, or steal from his mother.

Bad castings are like bad debts, their makers would like to deny them.

The man who closes up a mold without setting the cores, is generally figuring more how he can spend his money than how well he can earn it.

Dull iron is often like the Methodist backslider, caused by lack of wind from the blower.

A poor molder with a good job, is like a hog trying to play the piano.

The rumor of a "cut" is like rice pudding, easily assimilated.

'Tis a peculiar fact, bad cores always find their way into bad castings.

Clamps have a wonderful faculty of growing shorter or longer, when you try to find some to fit a flask.

The man who tells the boss, "I couldn't help it," is to be pitied for his ignorance and admired for his ingenious reply.

The expression "root" as applied to molders, no doubt comes from their associations with pig iron.

A molder can make a bed, put on the covers, tuck in *the corners, but he does not know how to air the sheet.

The rattler is like the world, the friction takes from castings their superficial covering like the world does from a man by its contact, revealing the perfect, pure and upright, or exposing the dirty spots, imperfections and patched-up corners.

Looking Backward.

By ROBERT D. MOORE.

One of the first mysteries I encountered in the foundry was that fine scrap thrown upon a ladle of melted iron, to cool it, floated. Arnott and other standard authors had been teaching that heat expands and cold contracts all the metals, and that, therefore, the cold iron should sink. It has been well proven, twenty-five years later, that all melted substances suddenly shrink just at the melting point more than they have expanded by heating, leaving the melted material the heaviest. Tallow, beeswax, etc., follow the same law.

Difficulties will confront everyone who enters a foundry with the intention of making it his home and one of my earliest recollections takes me back to a case that involved the casting of three hundred feet of socket pipe. They were three-quarter-inch bore only, five feet long, thin metal, cast on an incline. The core barrels were made of one-eighth inch gas tubes, one spear of hay forming the rope. A regular pipe molder had cast six a day for a week and did not get a piece eighteen inches long even after he had been assisted by the advice of the foreman and several journeymen. They were lost by violent blowing, and becoming interested, I reasoned that as the vent hole could not be enlarged much slower pouring might save them. I applied for the job, got it easily, and filled the order without losing a pipe, by pouring at less than one-fourth the former speed, thus proving that they were lost by gas being formed faster than it could be carried away.

A little later an important long casting came out crooked, when the pattern and mold were straight. A jury of three was then empaneled, composed of molder, foreman and manager, to sit upon the case; their verdict was, "cause of crook unknown to this jury." I listened with interest as it was right in my line of reasoning, and in a short time I was convinced I had found the true theory of the warp, as has been proven later by many years of experience and close observation. The theory is very simple, yet but few are found who have mastered it. The thin parts of a casting cools and shrinks first, making an effort to pull the casting out of line, but being held in place by the mold the soft parts yield, become upset, or shortened, which, added to the shrinkage, makes the heavy part shorter than its natural size, or more properly makes it the concave side, whereas the natural shrinkage would leave that the convex side.

A long two-inch plate with a half-inch rib four inches wide furnishes a good sample of a warping casting, which, if cast separate, the rib would be shortest and both would be straight.

About 1840 I saw a molder use a ball for a skim-gate and thought it a smart trick, soon after hearing about the whirl gate being applied in casting chilled rolls, to throw the dirt to the center. I applied that principle to the ball-gate, and claim this to be the pioneer whirl-gate.

In 1879, being engaged in engine work calling for many polished castings, I made

four pair, right and left, regular patterns, for skimming chambers. For economy two core prints were used, pinned together with large, hardwood pins, glued in and with a tongue for inlet gate. From 4-inch diameter to 2-inch diameter will fill all the needs of an average foundry. Some years later, in 1886, Thomas D. West's book appeared, giving a cut of such a gate, but there are two errors shown; the entrance sprue is curved when it should be straight; then the outlet is shown in such a position to be hit directly by the stream, when the metal should have a short run to throw the dirt to the center before reaching the outlet.

Molders almost universally believe in lighting vents to prevent blowing or scabbing, when it is only useful under a bottom board, in a core barrel, or other confined chamber to prevent the mechanical violence resulting from an explosion of gas after it has escaped.

What regulates the time required to cool off a 100-pound casting? say under a complete sand cover. That is as definite as the question what is the result of adding two and two; who can answer it? But that question has a useful side also, namely, what regulates the size of head required to feed a 100-pound casting most perfectly? which requires the same answer. Again, suppose a cylinder or flanged pipe cast in loam, on end say 50 inches diameter, 10 feet long, 2 inches thick, flanges projecting 4 inches, making 6 inches bottom face, weighing nearly five tons. When the walls are stripped off the casting the pressure on the bottom of mold will be five tons, but when the metal was fluid the pressure was over fifteen tons on that bottom surface.

These figures will strike the molder at first dash as being funny, but there is a useful feature, a hint of the strength required in the bottom ring to prevent settling between the stirrups. There have been many such disasters.

By careful observation I have formulated a rule by which to estimate the pressure of the iron on a mold, in any given direction, and consequently a correct guide in clamping, weighting, anchoring and in otherwise sustaining a mold during the process of casting. The rule is very simple; the pressure of the iron being one pound on each square inch for each four inches of hight. I advocate the use of river sand as a cheap and safe filling in cramped spaces in pitting loam molds when cast in rings or casings. Experiments made in 1849 proved that it required a pressure of 800 pounds per square inch to crush this material. This device was extensively used in the old Niles works at Cincinnati. Another theory which I have found to be correct in practice is that a green sand mold, disposed to scab, if raised to an inclined position, say of one and a quarter inches, to a foot, will entirely prevent scabbing. The theory is that the metal flowing up an incline plane will allow the steam to escape ahead of the metal and prevent the bubble, which always precedes a scab. Its application to several hundred cylinders, boiler-heads, etc., has justified me in this belief. Molders used to lose about half they cast by scabs, as there was no skin drying in those days, but by taking this prevention no material trouble was experienced. I discovered early that the swells on the surface between the teeth of a roll pinion made in a dry sand mold resulted from the expansion of the metal at the moment of congealing. This surface, being the last to cool yields to this irresistible expansion forming swells fully measuring as much as a quarter inch. By regulating the time of feeding the swells were reduced to any desirable degree. Experiments proved that a 14-inch pinion required to be fed 22 minutes only, and an 18-inch pinion 30 minutes. That time giving each the light swell desirable, as proof of being fed solid at the root of neck. This refers to roll pinions having a journal and coupling cast on each end for driving rolls uniformly. This discovery and theory used to be rated as occult philosophy, though it is but the result of a studious application. I have straightened long engine bed sides by lifting the ends of the iron flask, a few minutes after pouring an inch high, that being the amount of warp shown. They were twenty inches wide, eight inches deep, solid pattern, cored out with green sand cores made on a wrought iron skeleton and hung on the cope.

The secret in straightening castings like the above lies in placing such a casting on two bearings near the middle, then placing bearings under ends, say one inch below to

regulate the settling; then place weighted levers under the ends to take the strain off the center until fully heated, or soft. Putting on the weights should be the last act.

I believe that one feeding head will feed twice as long as two, and four times as long as four, on the same casting. To illustrate, feeding can be continued for an indefinite length of time through a six-inch feeding head if it would settle fast enough. No molder will dispute this proposition. I have many interesting facts in evidence to support this position. In removing the breaking strain from castings by heating the coolest parts I have employed melted iron as soon as they could be reached. Take the instance of a twenty-four-inch pulley; after removing the cope place a frame on the drag and cover the rim, then force a spade tool down against the outside of rim in about six places, pouring in a slab of iron about the size of hand in each space. Of the many hundreds of castings of all conceivable shapes I have treated in this manner not one broke. A six-foot valve seat plate, five inches thick, with nine ten-inch holes, to seat Worthington valves, for the Cincinnati Water Works, had its working lifetime increased from an average of twenty days to over one hundred days by spreading six hundred pounds of iron on the edge, and covering for two days.

Iron Smelting in India.

The iron industry in India progresses very slowly, the product last year being only 46,000 tons. The furnaces are almost confined to Bengal, and to those localities where coal is abundant in the immediate neighborhood of the ore, and where smelting can be carried on by European methods. From Dr. Watts' review of the mineral production of India we learn that ore exists in abundance in the Central Provinces, but the smelting is conducted in the most primitive fashion, and there are no authentic statistics. In Madras there is abundance of ore, but no fuel, while in Bombay there are both coal and fuel, but enterprise has not yet been systematically directed to modern methods of smelting.—Ex.

CAST IRON NOTES.

Devoted to Inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

Strength of Cast Iron.

As I mentioned in "Cast Iron Notes" for April, there were sent to me five test bars ½ inch square by 12 inches long, which I was requested to test and compare with the strength of the strongest iron made. The bars broke at 500, 498, 500 and 550 pounds when tested transversely. The chemist to whom I sent drillings from the strongest bar was not able to make a full analysis in time for me to use it. I didn't expect that an analysis would show the cause of strength, but it would give a chance for the statement that strength is dependent upon the character of the grain, and not upon chemical composition, except when some peculiarity of composition influences the grain. To be able to compare records of tests of cast iron there must be

UNIFORMITY OF METHODS OF TESTING.

Test bars in every foundry should be molded in No. 1 stove plate sand, and should be molded from the same form of pattern, and gated in the same way, and no facing used. The iron should be taken at the middle of a heat in a hot ladle, and all bars should be poured from one ladle as quickly as possible. Take the bars from the sand as soon as possible, break from the gates, and remove sand by a wire brush or scrape one bar with another. Grind off any portion of the gates that may adhere with an emery wheel. Place the bars in the testing machine in the same position as they lay in the mold, and test the bars as soon as possible after they are made. Each founder should pursue this exact routine.

VARIATION OF ROUTINE.

While each detail seems unimportant, yet no one knows how a slight variation may influence the strength. I prescribed the above routine in 1885 and have never deviated from it in any detail, therefore all of my tests are comparable. Bars made or tested by any other routine may be either weaker or stronger. To illustrate:

STRENGTH IS INCREASED BY CLEANING TEST BARS OR CASTINGS IN TUMBLING BARRELS.

A couple of years ago Mr. A. E. Outerbridge had quite an accumulation of untested bars. On account of the large number he thought to save time by milling the sand off. When tested, the bars were enough stronger than usual to attract attention. A repetition of the experiment produced the same result. As he was accustomed to watch for new developments, this accidental variation of routine led to this important discovery.

After I had broken the five bars referred to I noticed that they had been cleaned by tumbling, and found on inquiry that they had been in the mill somewhat more than one hour.

Here was the explanation of strength.

The following table gives tests of two casts. The test bars were cast in pairs and all were poured from one ladle. One bar from each pair was cleaned with a brush, while the other was cleaned in a mill:

	First Cast.		Second Cast.	
	Brushed	Milled 1 hr.	Brushed.	Milled. 2 hrs.
1.....	455	447	300	365
2.....	410	471	295	398
3.....	435	450	330	374
4.....	450	450	290	390
5.....	448	475	345	428
6.....	350	445	285	372
7.....	395	419	365	400
8.....	378	415	348	382
9.....	433	475	325	330
10.....	408	372	300	440
11.....	400	460	285	400
12.....	385	430	...	...
13.....	375	400	...	...
14.....	309	345	...	...
15.....	345	438	...	...
Av.....	398	433	315	389
	Gain, 9 per cent.		Gain, 23 per cent.	

If the bars sent me were in the mill one hour and gained nine per cent. the bars, if brushed, would have shown an average strength of 467 lbs., which is not uncommon.

If they were in the mill two hours the bars, if cleaned with a brush, would have averaged 397 pounds.

As near as I can judge, the maximum strength of test bars ½-inch square is reached by milling two hours. Milling longer does not often add to the strength of this size of casting. The percentage of gain depends upon the weakness in the brush-cleaned bars on account of the tension between the grains. As soon as each grain is free from the pulling influence of every other grain the maximum strength is obtained.

The jar produced by the striking of the castings upon each other in the mill enables each grain to adjust itself to the others.

If a bar cleaned with a brush, and its mate cleaned in a mill, had been analyzed, the chemist could not have found an explanation for the difference in strength. The gain was due to physical causes. Strength is always due to the character of the grain and is a physical property.

These examples show the necessity of an exact routine in testing cast iron.

The object for testing is to find how strong the casting is when it leaves the mold. A test bar will show whether a given iron is the best for a given purpose.

Iron that would make a strong soft casting ¼ inch thick, would probably make one 4 inches thick that would be full of spongy spots and very weak because of too coarse a grain. Gun iron, which would make a very strong casting if 4 inches thick and soft enough to machine, would, if cast in a test bar one inch square, be brittle and weak.

We have long known that we have less breakage when we clean our castings in mills than when we clean them by hand, but we are indebted to Mr. Outerbridge for the discovery of the reason for this result.

Correspondence.

WHY THEIR BID WAS HIGH.

Editor THE FOUNDRY:

In your April number we notice an item in regard to the great disparity between our price and that of another foundry for a certain amount of castings.

The castings referred to were for the City of Boston and the amount called for is about 1,375,000 lbs. more or less special pipe castings, branches and T's, named as No. 1 in specifications, varying from 6 inches to 24 inches in diameter and about 275,000 lbs.

more or less of other castings, such as are used by the City Water Works, named as No. 2 in the specifications. Our bid for the No. 1 was 2¼ cents per pound and for the No. 2, 1¾ cents per pound, delivered at the city yards.

The Mechanics' Iron Foundry Co. made this same work last year at $1.58 per 100 lbs. and they can show by their books that they lost $5,000 on the contract; besides this, the specifications this year require all the castings to remain in the tar vats not less than five minutes, which every foundryman knows would entail a large amount of extra labor and expense. In view of these facts, we made our bid at the prices we did, namely 2¼ cents per pound for the No. 1 and 1¾ cents per pound for the No. 2.

In justice to the Mechanics' Iron Foundry Co., all trade, as well as other journals, which have published, as some of them have, that our price was 2½ cents per pound, should publish this statement.

Yours respectfully,
MECHANICS' IRON FOUNDRY CO.

We are glad to correct any misstatements which may have been made, however even at 2¼ cents, the difference is large enough to cause some comment. We have heard several complaints made by experienced foundrymen on the competition to which they are subjected by outsiders, having but a limited knowledge of the cost of producing castings. Of course the latter get their fingers burnt, but there can be but little satisfaction in this for anyone. We noted the difference in price in this case largely because the foundry which obtained the contract is a recently organized co-operative concern. It is also a fact that molders are generally in the habit of exaggerating the profits which their employers are supposed to pocket. To many of them it appears as if the difference between the cost of iron, coke and molding and the selling price of castings must be the profit. They forget the many incidental expenses connected with operating a foundry, and when they obtain a contract they become by experience wiser men. When the Co-operative Foundry Co. has finished this contract, we will be pleased to have it tell us, as an example of good shop management, how it made a profit where others scored a loss.—Ed.

VOLUME OF AIR IN MELTING.

Editor THE FOUNDRY:

At the risk of being considered impertinent for intruding my ideas unasked into the discussion of my fellow craftsmen, I yet feel that I am not guilty of an infraction of foundry etiquette in saying something upon a subject of such vital interest to practical founders, as to the best method for supplying cupola furnaces with the proper volume of air to attain the best results in melting iron, and as what I may say is based upon a practical experience of forty years in melting iron, it certainly is not snap judgment, but may be attributed by some of the progressives to fogyism. As a general principle my experience in different foundries with different kinds of cupolas has taught me to believe that to melt iron economically and successfully it is necessary that a given volume of air should be measured out to the furnace and passed through tuyeres of a total area equal to 1-12th of the area of the drain of cupola at the presumed melting zone. From a series of experiments made forty years ago, I found that the proportion that produced the best result was 1.65 cubic feet per minute for each square inch of area at melting zone; this with hard anthracite coal. The blowing machine consisted of a pair of pump cylinders driven by a double engine with a speed gauge attached, which indicated at a glance the number of revolutions of engine, the cubical content of air cylinders being known there could be no mistake about number of feet furnished. The only use I ever found for a pressure gauge was as data for calculating the amount of horse power consumed in driving blower, and when insufficient area of tuyeres existed to demonstrate the fact that much fuel that might have been used profitably in melting was wasted in creating the extra power required in overcoming the pressure caused by not having enough tuyere area. If speed indicators were substituted for pressure gauges and the air allowed to enter the furnace without obstruction and in the proper quantity, mysterious heats would be of less frequent occurrence. I claim that the true principle in melting iron in a cupola is to introduce the amount of oxygen that will chemically combine with the carbon of the fuel, through ample tuyeres regardless of press-

ure. I found this good practice forty years ago, and have adhered to it ever since. In the proceedings of the Western Foundrymen's Association in this month's FOUNDRY, I was struck by the statement of the performances of Mr. Hanna's three cupolas. Assuming that his cupolas were straight inside, he must have used 4.378 cubic feet per minute in the 32″ for each square inch of area at melting zone, 4.4 for the 40″, and 2.8 for the 60″. I will merely mention that I have melted 12 tons per hour in a No. 12 Mackenzie, having about 60″ diam., using but 1.65 cubic feet per square inch of melting area, with nominal pressure, due only to resistance of charge.

J. I. B.

CASTING IRON ON BRASS.

Editor THE FOUNDRY:

In answer to V. W. D.'s request for information in regard to casting iron on brass, would state that when I had charge of the iron and brass foundries of the Eddy Valve Works at Waterford, N. Y., I cast a great deal of brass on iron and iron on brass. The pieces that we cast the brass on the iron were what was called the stem, or screw, for raising the gates in the valve.

The piece that the iron was cast on the brass was called the ball. This piece is connected to the gates and the screw turns through it when the gates are raised.

The stem patterns were very nearly straight with the exception of a shoulder of about an inch or so with a print at each end and from 9 inches to 4 feet in length; but we did not put any iron in the longer lengths. The remedy to stop the blowing is very simple: The rods were put in a fire and made red-hot, and when the metal was ready put them in the mold and cast as quick as possible. Be sure to have the prints on the ends wet so that the iron will not dry and crumble it. If proper care is taken there will be no trouble from blowing and the castings will turn out all right.

In the second place, where the iron was cast on the brass, these castings weighed from 4 to 450 pounds. With the smaller ones we did not have much trouble if proper care was taken. Occasionally I would see that they had been cast too hot, as the melted brass would show itself on the bottom of the casting.

With the larger ones I had considerable trouble. At first we tried everything we could think of, but when the casting came out the brass was melted and all on the bottom of the casting. At last I hit upon a plan that went through all right. I took the brass and made it warm (not hot enough to frizzle), then got some molasses water and mixed half flour and plumbago thick enough to put on with a brush, when the brass got cold I warmed it again and again until I had a thickness of about a sixteenth of an inch of covering, and then it was cast. The gate was cut of an unusual size, large enough to dump all the iron in at once (as us molders would say). Let the iron stand in the ladle till it is very dull then pour.

In my communication appearing in the March FOUNDRY on cast iron tools you have it that I worked in a foundry where they made a large number of "old" pipe, it should be "oil" pipe. Please correct this, as a number of my friends wish to know how we made "old' pipe at that time.

THOS. WATHEY.

Cleveland, O.

DOES SOFT IRON HAVE THE LOWEST MELTING POINT.

Editor THE FOUNDRY:

The discussion which has been entered into with so much zest by some of the contributors of THE FOUNDRY, as to whether soft iron melts at a lower temperature than hard iron, invites investigation. The writer has previously described one way by which this may be determined. Two pigs, one soft and one hard iron, laid upon the plate at the bottom of the charging hole in a cupola after the last charge has been put in will most conclusively demonstrate which is the more refractory. The soft iron will invariably melt first.

Recently it has been our good fortune to be able to more accurately determine the fusing temperature of hard and soft metal. For this purpose a platinum-iridium couple was used connected to a tangent galvanometer furnished with an astatic needle. A furnace and tube muffle completed the apparatus. The samples in contact with the couple were introduced into the muffle and the temperature slowly raised. The soft metal fused at 1065 centigrade, while the

hard metal required nearly 100 degrees more of heat.

A few words from Prof. Ira Remsen, of John Hopkins University, who is an acknowledged authority upon all points in chemistry and physics, may be apropos. On page 360 of his Treatise on Chemistry, he says: "The gray iron fuses at a lower temperature than the white." * * *

I hope that this may cast some light upon a much discussed topic.

Cincinnati, O. S. S. KNIGHT.

OPEN AND CLOSED FEEDING HEADS.

Editor THE FOUNDRY:

I have carefully read and considered the subject under discussion between Mr. West and others in reference to covering sink-heads or risers and also the so-called drawing down of copes over large bodies of metal. I am a little surprised that none of these learned writers on foundry practice has discovered the true cause. A few simple experiments will prove to any practicable molder that the following theories are correct. It is the practice, after the joint or parting is made, for the molder to riddle or distribute a quantity of facing over the pattern before putting on the cope, and if the latter be large considerable time is taken up gaggering, and by the process generally used by molders the facing is give ample time to dry. The putting up of molds in a draft or the molder running short of gagers often cause smaller molds to dry out. When the first filling is put in there is more or less of a parting, formed by the drying out of the facing, which may be of stronger sand than the body of the mold tending to form a parting which, when the mold is filling and the heat expanding, forces off flakes the thickness of the facing. Now, to prove that this theory is correct, all that is necessary is to subject the cope to a quick, severe fire, and you will readily see the cause. Or to illustrate further, take a mold and ram it up well with dry facing, blacken and slick it and put it in the oven, which has been very well heated, and you will find the same thing occur just as far as the blacking has penetrated, the sand will form a shell which will separate itself from the body and come off in cakes before a mold is poured. One of the best methods for testing sand is to form it into some shape, then subject it to an intense heat similar to that endured by a mold when being poured; if the sand will brown and dry solidly, being open enough to admit the escape of the gases and steam, you can rest assured that if properly treated it will stand the iron; but if when drying it crumbles and is easily pulverized it is not safe.

The writer has discovered that when a very large surface is to be covered it is best not to put the facing over too large a surface at one time so that it can be gaggered and filled up before it has time to dry. If this course is pursued there will be no dropping away, regardless of vents, if properly rammed, and if the filling sand is reasonably as strong as the facing and properly tempered.

With regards to covering sink heads. It is certainly a much safer practice to cover up sink heads, especially where there are a large number of cores almost entirely submerged in the mold, for the reason that a certain portion of the vent will escape from the cores into the mold intead of passing out through the vents provided, and if allowed to escape through the riser it will cause the iron to bubble and very often blow out; but if the riser be covered, an air pressure will be added to that of the iron forcing the vent out through its proper opening. It is also a very good practice to build the risers and gates so high as to make the pressure of the iron strong enough to answer the same prpose. If the cope is sufficiently closed to prevent the vent from forcing its way through the risers and the gate being kept well filled it will be forced through its proper openings.

In regards the air pressure, in the interior of a mold, preventing it from running. It is well known that the iron will run better in a closed mold than in an open mold; the defections in small projections in the cope, short flanges and lugs, which are often short, can be laid more to hard ramming than to air pressure, as they come more in contact with the rammer than any other part of the mold, if proper care is not taken.

Springfield, Ohio.

JOHN G. SADLIER.

The common copperas of commerce, so extensively used as a disinfectant, is a salt of iron, the sulphate.

Obituary.

JOHN STEDMAN.

John Stedman, the founder and general manager of the Stedman Foundry & Machine Company, Helena, Mont., died on the 8th inst. of heart failure. Mr. Stedman was 60 years old, and one of the most prominent citizens of Helena, where he has resided for about 30 years.

JOHN HANES.

John Hanes, a prominent citizen of Pennsylvania, died at Eldridge Hill, near Woodstown, Pa., on March 24, at the age of 79 years. Forty years ago he and his brother, Thomas, started an iron foundry and machine shop at Woodstown, which they conducted up to within a few years ago.

HARRISON Y. KRAUSE.

Harrison Y. Krause, manufacturer of agricultural implements at Krausdale, Lehigh county, Pa., died suddenly at that place on March 24 of apoplexy, aged 59 years. Mr. Krause was one of the founders of the works for the manufacture of farming implements 30 years ago, and up to the time of his death was in charge of the practical part of the business.

JOHN THOMAS.

Mr. John Thomas, one of the best known men in the iron industry, of Eastern Pennsylvania, died in Hokendauqua, Pa., March 19. He was the son of David Thomas, a pioneer in the anthracite pig iron industry and succeeded his father as superintendent of the Thomas Iron Company. He relinquished this position four years ago and was followed by his son.

EDWIN S. BARBOUR.

Edwin S. Barbour, president of the Detroit Stove Works, at Detroit, Mich., died in that city April 6 of a complication of diseases. It is believed that the primary cause of the slowly developed troubles was the injuries he received in a railway accident in 1892.

Edwin S. Barbour was born in Canton, Ct., Nov. 19, 1832. His father removed to Collinsville, Ct., while he was still an infant, and there conducted a general store. Edwin received the first rudiments of his education in the schools of Collinsville, but left school early in his boyhood and entered his father's store as a clerk. At the age of 19 years he left home and went to New Haven, following that general impulse of ambitious country youth, to enter the broader field for the development of their ambition found in the metropolitan cities. Unlike many another, he did not return as the prodigal son to his father, but won success. He secured employment as a clerk in a wholesale dry goods establishment. He went to Chicago in 1855, but finding no opening there, returned east as far as Detroit. Here he grew with the city, and, subsequently became one of the business structure of the country.

He was married in 1863 to Miss Ella Tefft, the only daughter of William H. Tefft, then president of the Detroit Stove Works. The

EDWIN S. BARBOUR.

marriage to the daughter ultimately resulted in joining fortunes with the father, and in 1870 Mr. Barbour became secretary of the stove works. He held this position until 1884, when he became vice-president, and upon the death of Mr. Tefft succeeded to the presidency. His wife and two children, Mrs. William G. Henry and William Tefft Barbour, survive him. Frank Tefft Barbour, another son, died last June, and this loss had greatly to do with Mr. Barbour's decline, for he never fully recovered the shock that the loss of the son gave him.

In Mr. Barbour's death Detroit loses one of its most respected, public-spirited and energetic business men.

Fire Fiend.

The Phoenix Foundry, of Oakland, Cal., was damaged by a recent fire.

A small blaze took place at the shops of the Fremont Foundry & Machine Co., Fremont, Neb., on March 27.

Adam P. Stoddart & Co., of Gloucester, Mass., suffered the loss of a number of patterns at a recent fire.

A fire, originating from what is claimed to be spontaneous combustion in greasy waste, caused a $5,000 fire in the National Foundry & Machine Company's works at Louisville, Ky., on March 26.

A fire was discovered March 27 in the Alonzo Newbury foundry, West Coxsackie, N. Y. It started in the molding room and was probably caused by some flasks catching fire from castings. The loss was slight.

A fire at the Hannibal & St. Joseph railroad shops at Hannibal, Mo., on March 27 caused a loss estimated at $4,000. The fire consumed the tin and boiler shop and the brass foundry, with all the tools and patterns. In the brass foundry there were about $1,500 worth of patterns.

The foundry of the Glenville Machine Company, at Glenville, Pa., was destroyed by an accidental fire March 21. The loss will reach $4,000. Partially insured. The foundry was owned by Thomas E. Jenkins, of Baltimore; Thomas Klinefelter, of York, and Oliver Klinefelter, of Glenville.

Until 1730 the smelting of iron was always performed with charcoal, nor was its use wholly superseded in large foundries by coal and coke until 1788, and indeed in many establishments and for several kinds of manufactured iron charcoal is still employed.

Among the Foundries.

At Denver, Col., a foundry will be erected by George G. Jackson.

J. F. Newell & Co., of Gardiner, Me., are erecting a brass foundry.

W. T. Stamps is talking of erecting a new foundry at Knoxville, Tenn.

Rathbun & Conville have rented the Alpha Foundry at Alpha, Ill.

E. C. Stoner is establishing a foundry at Riverside, Cal.

W. T. Stamps is preparing to start up a foundry at Knoxville, Tenn.

O. G. Thomas will shortly build an addition to his foundry at Weir, Mass.

Pundicion de Carmen is the name of the new foundry which Mr. Chris Erichson & Co. are establishing at Monterey, Mexico.

R. H. Menereys will shortly commence the erection of a brick foundry building at Yale, Mich.

Peter Van Huffel, of South Bend, Ind., contemplates moving his foundry and machine shop to Gilman, Ill.

The Charter Oak Stove and Range Company, St. Louis, Mo., has increased its capital from $50,000 to $100,000.

Mr. Thos. Moran, of Youngstown, O., has established a business at the foundry of Curry & Co., at Meadville, Pa.

Shaw & Fowden, the new foundry firm at 703 Edgmont avenue, Chester, Pa., will open up for business at an early date.

The Slater Engine Co. have established a new foundry at Warren, Mass., and will hereafter make their own castings.

Lang & Scharman, of Marshfield, Wis., have let the contract for the building of their new foundry and machine shop.

The Henry McShane Mfg. Co., of Baltimore, is removing its entire plant to Dundalk, Md., where it obtains better facilities.

E. H. Potter and O. W. Edmonds, the foundrymen of Mound City, Mo., have dissolved partnership, O. W. Edmonds retiring.

The Waukesha Malleable Iron Co., at Waukesha, Wis., are considering the advisability of erecting a large addition to their plant.

The Waukesha Malleable Iron Co., of Waukesha, Wis., is reported to have increased its capital stock from $60,000 to $100,000.

The Kepp Gear Wheel and Foundry Company will build a one-story brick and frame foundry on South avenue, near Walker street, Allegheny, Pa.

The recent flood has caused a great deal of inconvenience and some loss to the industries located along the Pittsburg bank of the Allegheny river. The Fort Pitt foundry of Mackintosh, Hemphill & Co., and the Pittsburg Steel Casting Co. are among the foundries affected.

Alexander McKenzie, formerly of Holyoke, Mass., has taken a position as superintendent with the Co-operative Foundry Company, of Lynn, Mass.

The Dickson Foundry & Machine Shop, of Dickson, Tenn., recently purchased by Scott Bros., of Birmingham, Ala., has added to its plant a complete brass foundry.

The Shaw Steel Casting Company has been incorporatd at Milwaukee, Wis., with a capital stock of $5,000, by M. Abraham, Solomon Shaw, and Louis V. Shaw.

It is said that Heermans & Lawrence are about to close a deal, whereby they will purchase the machine and foundry of Preston & Heermans, located at Corning, N. Y.

The Donaldsonville Foundry & Machine Works, at Donaldsonville, La., has decided to make some notable additions to the equipment of their establishment which will enable them to handle a heavier class of work.

The foundry of the Glenville Machine Co., lately burned at Glenville, Pa., is to be rebuilt of brick and iron and made fire-proof. The loss by the fire was about $3,000; insurance, $2,300.

Phillips & Debord have bought the Huntington, W. Va., heating and ventilating plant, which has been idle for three years, and will operate same as an iron foundry for general work.

The Toledo Brazed Fork & Tube Company, of Toledo, O., is arranging to add a foundry and machine shop. John B. Winslow, formerly of Findlay, is now managing the business.

M. C. Howard and J. C. O'Donnell have organized the Black Hills Manufacturing Co., at Deadwood, S. D. A building 40x140 feet will be erected to accommodate the foundry and machine shop.

The National Foundry and Pipe Works Company has started its new plant at Scottdale, Pa. The plant will be run entirely by electricity and will manufacture the largest sizes of pipe, producing 150 tons per day.

Mr. O. A. Wyman and T. H. Widdowson, of Albert Lea, Minn., have bought the Austin, Minn., Foundry and are preparing to enlarge and reopen the business. They expect to commence operations in the near future.

The Hyde Windlass Co., of Bath, Me., have nearly completed their new plant. The buildings include a foundry, machine shop and pattern shop, and has been fitted with electric cranes. The plant is heated with hot air.

The Peekskill (N. Y.) Stove Works has purchased the stock, patterns and business of James G. Lyon (successor to P. Rollhans, Jr.), No. 24 Water street, New York, and on or about May 1st will remove their New York store to that address.

Thomas T. Frazier has purchased the patterns of the Leaf Stove Company, of Phillipsburg, N. J., and will remove the entire plant to Lansdale. Mr. Frazier had been employed by the Leaf Company for some years and is thoroughly acquainted with the trade.

Chas. A. Pratt, late superintendent of the Star Foundry, Worcester, Mass., has, in company with Owen McArdle, John Crowley, Henry Herbert and George Steele, rented the Worcester Steel Works, at Worcester, Mass., and will conduct a general foundry business.

John Gage, of Henniker, N. H., has purchased of Paige Brothers the foundry at Hillsborough Bridge, N. H. Mr. Gage intends to conduct a general foundry business, and will run it in connection with a machine shop. He will also engage in the manufacture of water motors.

The Cohoes Iron Foundry & Machine Company, of Cohoes, N. Y., comprising the property of the late David Johnston, has been incorporated with a capital stock of $50,000 by Anna E. Johnston, David S. Johnston and Sarah J. Shields. Jerome Garland is superintendent of the plant.

The Andrew B. Hendryx Company, of New Haven, Ct., has added a complete bronze and brass foundry to its Audubon street works, and purchased the entire plant of Messrs. Henry E. Preiss & Son. The company is prepared to supply bronze, brass, aluminum and white metal castings.

The Power City Foundry & Machine Company, of Niagara Falls, N. Y., has been incorporated to do a general foundry and machine business. Capital, $10,000. The directors are: Alexander R. Gow, Joseph W. Sheperd, Fred C. New, John Conroy, John N. Anderson and Peter R. Gow.

The Ideal Foundry Company has been incorporated at Piqua, Ohio, with a capital stock of $10,000. The incorporators are James Stewart, G. F. Schnaufer, Charles T. Barber, Frank E. Barber and George B. Jones. They will manufacture stoves and do a general foundry business.

Benedict & Crawford, of East Randolph, N. Y., closed up a deal lately whereby they become the owners of the Salamanca (N. Y.) Iron Works Plant, opposite the W. N. Y. & P. depot. It is understood that the new owners will erect new buildings and put the plant in a first-class condition.

The contract has been awarded for the erection of the new foundry buildings of the Walker & Pratt Manufacturing Co. at Watertown, Mass. These buildings are to be completed in five months, and it is expected that the plant will be in operation next fall. The buildings are mainly of one-story.

McNamara, Koster & Co.'s foundry and pattern shop, at Indianapolis, Ind., was entered by vandals recently and a large amount of property was destroyed. The office was entered and desks broken open, but nothing of value was found. Then the pattern room was visited and a number of valuable patterns were ruined.

The stove manufacturing concern of White, Warner & Co., of Taunton, Mass., has become incorporated and taken Mr. Tinkham, of Norton, formerly of the Magee Furnace Company, into partnership. It is the intention of the company to go into the furnace or combination heater business as soon as arrangements therefor can be made.

The Union Iron Works, of Columbus, Ga., succeeds the Peker Iron Works, with the following officers: President, Wm. H. Brannon; secretary, C. J. Edge and superintendent, C. T. Peker. It is understood that the company will erect a new foundry and machine shop as soon as it secures a suitable location.

The American Sand Company, of Columbus, O., has been incorporated by G. C. Hoover, E. G. Savage, F. A. Downerd, B. E. Hyde and L. W. Mead. The capital stock is $10,000. The company is formed for the purpose of manufacturing, mining and selling all kinds of sands and clays, coal, coke, iron, stone, clay products, foundry facings and foundry supplies.

Work has commenced on the new blast furnace to be built by the King, Gilbert & Warner Company at South Columbus, O. The ground for the building and tracks is being graded and the construction will be commenced in a few days. Three-quarters of a mile of track will be laid in the furnace yard, which will connect with the Hocking Valley & Toledo and Ohio Central tracks.

The Semi-Steel Co. has been incorporated at Chicago by Rockwell King, Martin Andrews and William Frances. The business of making semi-steel castings heretofore done under the name of the King & Andrews Co., at 216 to 222 North Union street, will in future be executed by the Semi-Steel Co., noted above. They have recently been adding greatly to their facilities for turning out heavy work.

The Edward P. Allis Company, of Milwaukee, Wis., have purchased the business formerly carried on by the Hercules Iron Works, the Hercules Ice Machine Co., and the Reliance Engineering Co., of Aurora, Ill., and are prepared to supply repairs on all ice and refrigerating plants erected by them as well as figure on new machines for this purpose and of any required size from 1 to 500 tons refrigeration.

The Globe Foundry Company, of Worcester, Mass., the new corporation of former employes of the Star Foundry Company, which ceased to do business some time ago, organized recently by the election of George Steele, president; Owen H. McArdle, vice-president and superintendent; Charles A. Pratt, treasurer and secretary; John P. Dwyer, clerk. Mr. Pratt was formerly treasurer and manager of the Star Foundry Company.

It is stated that a plan is under way to organize a stock company and purchase the patterns and machinery of the Fall River Machine Company and that of Fyans, Fraser & Blackway, at Fall River, Mass. It is said that the capital stock of the new company may reach $250,000, and that already subscriptions have been invited. The Fall River Machine Company, it is understood, has indicated a willingness to sell. The new scheme contemplates a larger plant on a new site.

It is reported from Salt Lake City, Utah, that a foundry will be built and all foundry work for the Oregon Short Line will hereafter be done there. This change is made necessary by the segregation of the Oregon Short Line from the Union Pacific System. Heretofore it has been done at the shops in Omaha. The Salt Lake shops will be under the care of David Patterson, who has been connected with the Union Pacific System for more than twenty years, and who began as an apprentice in the Omaha shops.

The Hoffman & Billings Manufacturing Co., of Milwaukee, Wis., has completed a deal for the removal of its large pipe works to Gadsden, Alabama. The company will consolidate with the Weller Pipe Co., and the combined plant will have a daily capacity of 45 tons. The new concern will be known as the Hoffman, Billings & Weller Manufacturing Co., with a capital stock of $100,000, and about $60,000 will be expended in extensive additions to the buildings and machinery. The officers are: President, W. H. Weller; vice-president, F. Hoffman; secretary, G. Schumaker, and treasurer, J. B Kalvelage. The company's offices are at 96 Second street, Milwaukee, Wis.

The assignees of the J. H. McEwan Manufacturing Company, of Ridgway, Pa., pursuant to an order of court, have sold the plant to Perry R. Smith and H. S. Thayer, both of Ridgway, at public sale for $120,050. A new stock company will be formed. The new company represents all stockholders of the old company except John E. DuBois, of DuBois, and J. H. McEwen, of Ridgway. The Ridgway Dynamo & Engine Works will be the name of the new corporation. As soon as a charter is secured the works will start up and furnish employment to 250 men.

The Cost of Iron as Related to Industrial Enterprises.

The steadying effect of an ample visible supply of any staple article of manufacture is apparent, but the importance of this in the case of pig iron is far from being appreciated. In fact, there is in the United States no great staple article that is allowed to drift so helplessly in the storms and sunshine of trade as this important product. It is generally admitted that no manufacturing business can be safely carried on, or made reasonably continuous and profitable, if it depends upon a raw material that is subject to great fluctuations in price. Iron enters more generally into all the great enterprises and improvements of this age than any other staple. It is, therefore, of the first importance that the fluctuations in its price should be confined within reasonable limits; otherwise the business of the whole country must be disturbed, when these excessive fluctuations occur. To realize how important the price of pig iron is to a long continuance of the prosperous condition of general business, we have only to consider the universality of its use, and to examine the effect its fluctuations have had on the business of this country in the last 50 years.

The history of pig iron in the United States is a succession of periods embracing a quick and enormous advance in price, followed by a quick and enormous decline, resulting in several years of depression and unremunerative prices. These abnormal advances have been caused in every instance, writes George H. Hull in the Engineering Magazine, by the small surplus stocks carried in the United States, and the struggle of each manufacturer to obtain enough to supply his needs at each recurrence of a general revival in business.

It was the revival in business and small stocks in 1854 which carried iron from $19 to $50. Everything was prosperous, but $50 iron put a stop to many of the great enterprises; thousands of men were thrown out of employment all over the country; the new furnaces built on high prices came into blast, prices commenced to tumble, and the great panic of 1857 resulted; the price of iron had fallen to $27—but it did not stop there; it continued to fall, until it reached $18 in 1862. The five years of depression ruined furnacemen, right and left, and many of their plants fell into decay.

Stocks were again at a low ebb when the revival of business in 1863 put iron on the up-grade again; there was an actual famine in iron. Prices jumped several times, as much as $5 per ton in a single day; but even $50 iron could not stop the prosecution of the war and its attendant necessities, and iron during the following year reached $80 per ton in the Middle States, and $74 per ton in the East.

After the great war-consumption ceased, iron dropped to $35 (in 1870), but the increased demand of 1872 put the price up to $60 in the Middle States; again the great enterprises were stopped by the high prices, and the panic of 1873 soon followed. Within the first year of the panic it dropped to $35, which was less than actual cost in the Middle States, labor and all raw materials entering into its production having advanced so largely in 1872; but it did not stop at $35. It continued to drop, until it reached $20 in 1879, and in these six years it was produced at a constant loss, as a decline in the price of iron always precedes, by a long period, the reduction in the cost of its manufacture. Again, in 1880, the small stock and renewed business carried iron to $45.

Will anyone claim that these enormous advances were not important factors in stopping the building of railroads and other large enterprises in each of the periods named, or that the discharge from employment of many thousands of workmen which this stoppage occasioned, was not the beginning of the panics that followed? No other great staple is subject to these enormous fluctuations, for the reason that larger stocks of the other staples are carried; but just in proportion as you stop the consumption of pig iron, the consumption of lumber and most other great commodities is checked. It must, therefore, be admitted that a large accumulation of surplus pig iron in seasons of dullness is the only condition that would prevent these enormous advances in prices when prosperous business periods return; but the question is: How can these large surplus stocks be accumulated and carried without injury to the furnace business?

Experience proves that the manufacturers of pig iron rarely carry a combined stock exceeding two or three weeks' production, and that the accumulation of even one additional week's production will carry prices down unreasonably. Manufacturers make their iron to sell; if they cannot get one price they will usually take a lower. Some of them have money enough to accumulate iron; others have not. The poorer furnaces, which are compelled to sell, lead the decline, and the rich ones must accept the price made by the poor ones. Experience proves also that consumers of pig iron will not carry large stocks. Among the few that have surplus money in their business, some addition is made to stocks when prices are going up; but, in the several years that prices are going down, consumers generally buy to supply only their immediate wants, and at no time is their stock so light as at the end of several years of depression.

As a broad principle, then, large surplus stocks of pig iron will not be carried by either the manufacturer or the consumer. It will be done only by some middle element, as is the case with other great staples. In the case of general articles of trade, like dry goods and groceries, it is done by the jobber and retailer; this we will designate as "natural carriage." In the case of large staples, like cotton, grain, petroleum, provisions, and pig iron, it can be done only by storing the article itself, issuing a negotiable certificate against it, and bringing about general dealing in these certificates on exchanges; this we will designate as "certificate carriage," or "warrant system." Every great staple except pig iron has had this "certificate carriage" established for it in this country. In the case of each of these staples the majority of the producers at the start have been unfavorable to the introduction of that particular commodity on exchanges. They reason that, if the small "natural carriage" of surplus stocks depressed prices, a large "certificate carriage" would depress prices more violently still. They reasoned, too, that the fluctuation in that article would be increased by its introduction to exchanges.

A careful examination into the history of every staple article that has been introduced by certificates to exchange dealings proves that both of these theories are unfounded. On the other hand, an exhaustive examination shows that the extreme fluctuations have ceased, in the case of each of the staple articles, after the introduction of that article to exchange dealings. We will give but one illustration:

Petroleum, before it was introduced on exchanges, showed violent fluctuations for nine years, ranging from 52 cents to $7.88 per barrel at the well. A surplus stock of a half million barrels carried the price down to 52 cents. The extreme fluctuations for nine years after it was introduced to exchanges was from 64 cents to $1.06, and a surplus stock of 36,000,000 barrels carried the

price down only to 64 cents. Every great staple that has been introduced to exchange dealings in this country has experienced like results, the producers of these articles, as well as the consumers, realizing a steadying effect not experienced before. Just in proportion as pig iron enters into the general business of this country will the general business of the country be benefited by the introduction of a system that would curtail the violent fluctuations in its price.

It is believed by some that this "warrant system" will not absorb large stocks of pig iron, and they cite the fact that even moderate lots of 10,000 or 20,000 tons of speculative pig iron, such as have been carried during various times in the last 20 years, have always depressed the price; but they lose sight of the fact that these speculative lots have been carried by negotiable storage receipts, and such carriage has always been, and always will be, harmful to the iron trade. There is, however, between this carriage and the carriage by a negotiable certificate dealt in on exchanges, the widest difference.

This "warrant system" has existed in Scotland for over 50 years, and for 30 years out of this time surplus stocks of pig iron in Scotland have been equal to from six to twelve months' production. During one period the stock for five years in succession exceeded a year's production. What better assurance can there be of the benefit of this system than its 50 years' history in Scotland? That market has not been subject to the violent fluctuations which have occurred in the United States, and the manufacture of iron in that country has been more uniformly profitable.

Many believe that the investing and speculative public will not absorb a large stock of pig iron through exchange dealings, but there is no real foundation for this doubt. The public will not carry unnegotiable storage receipts, just as the public would not carry petroleum stocks until they were put in proper shape; but, as soon as these stocks were represented by exchange certificates, the public quickly absorbed 36,000,000 barrels, and carried it without any depressing effect, and that same public will carry all the surplus pig iron that can be accumulated in this country under the "warrant system." More than one-fifth of the entire wealth of the United States to-day is invested in the carriage of property represented by certificates. The addition of stocks, bonds, and certificates on the New York Stock Exchange alone averages about 400,000,000 per annum. It is really the only shape into which property is put in which the money may be said to seek the property. There is no reason to doubt that this class of money owners will absorb all the surplus iron that is represented by negotiable exchange certificates. They have absorbed like certificates for all the surplus cotton, grain, petroleum, provisions, etc. The actual expense of carriage to the investor, on pig iron, is about one-fourth what it is on all these other great staples. It is this feature that has tended largely to make pig iron warrants the favorite speculative commodity in Great Britain for many years.

We have had no such violent fluctuations in price of iron during the last ten years as we had during the 30 years previous, for the reason that we have had no such violent and long-continued panics, and the cost of iron is permanently lower; but the moderate revival in business in 1889 and 1895 caused an advance of 75 per cent to 80 per cent, and these ruinous fluctuations will continue until large surplus stocks are carried.

This "warrant carriage" not only is a benefit to the trade during seasons of business activity, but is of equal benefit in another way during seasons of depression—by absorbing the surplus as it is made, thus enabling the furnaces to continue in blast, without overloading and depressing the consumers' market, whereas, without this system, the furnaces go out of blast, in about the proportion that the consumers cease to buy. We have had an illustration of this during the last few months.

In the Shenango and Mahoning valley, where the "warrant system" had not been adopted, there were, in January, 22 furnaces in blast, 19 of which had gone out of blast by August 15. In the Alabama and Tennessee district, where the "warrant system" had been adopted by most of the furnace companies, there were, in January, 32 furnaces in blast, only seven of which had gone out of blast by August 15. In fact, every furnace company in the southern district which had adopted the system was not only able to keep its furnaces in blast at the time of greatest depression, but was able to sell, through exchange warrants, all its surplus stock at satisfactory prices. An effort to

force off 10,000 tons in the first named district during the depression in August resulted in only a small sale, at $1.50 per ton below quotations, whereas, in the southern district, where the system had been adopted, 50,000 tons were easily sold by warrant, at the same time, on a concession of ten cents per ton, followed by a sale of another 50,000 tons at a substantial advance.

The conditions in these two districts were very different, but this does not affect the point we wish to illustrate—namely, that the previous introduction of the "warrant system" in the South had created a trade for southern warrants which quickly absorbed all the surplus iron as soon as the demand from the consumers ceased, a condition wholly lacking in the valley district.

A prominent iron master of Great Britain recently said, in reply to a question as to the usefulness of the "warrant system" to producers and consumers in Great Britain: "They simply could not get along without it. It is a necessary adjunct to the iron business. Consumers and dealers who desired to make prices on large lots of manufactured iron and steel for long future delivery would be obliged to take a large risk of the market, if it was not for the 'warrant system.' As it is, they can always protect themselves on these bids by purchases of warrants. Then from the producers' point: Furnace companies having on their yards a large stock of iron, or a large stock of raw material, if they anticipate a decline in the market, can telegraph to Glasgow and sell 10,000 to 20,000 tons by warrants within a few minutes, without affecting the price more than one or two pennies, whereas, if they attempted to sell a like amount of iron to consumers, they might be a week in doing it, and would depress the consumers' market as many shillings, as they would pence by selling on the warrant market."

The general adoption of exchange dealings in pig iron would enable the producers to market all their surplus product in case of depression, without undue lowering of prices. The accumulation of large surplus stocks through this means would not prevent a reasonable advance in prices in seasons of large demand, but would prevent the enormous advances which quickly hamper and eventually paralyze great enterprises. "Stability of value is the safeguard of the producer and consumer alike."

Changes in the Elasticity of Iron.

Wrought iron and steel are more apt to tear and to break than was supposed generally in former times. It has to suffer from exterior influences, as wear and tear, shock, tension and rust. A piano string of 1-10 inch thickness can stand a burden of up to 500 pounds without breaking, but bent several times in different directions it would lose one-half of its carrying power. By the sharp bending the small crystals of the original structure of the iron have changed their position, and thus lost their hold in each other. Iron and steel remain crystalline substances, which fact cannot be altered by any chemical process. As another example we could take the axle of a locomotive, which is manufactured to stand eight to ten times as much wear as is ordinarily demanded of it. Yet after a shorter or longer time of use it will break suddenly by reason of the continual shocks and jolts to which it is subjected, for iron has the property to return to its original state when exposed to shocks; it loses in elasticity, and finally it breaks. As wrought iron suffers greatly from changes of temperature, expanding in heat and contracting in cold, defects in bridges and other structures arise. All these structures are exposed to wind and weather; while in the day time the iron parts are heated by the rays of the sun, at night they cool off quickly. As iron is very sensitive, a continual difference of length is caused in the traverses and diagonals, riveted and bolted together as solidly as possible; the original length is never accurately recovered, but the crystalline structure of the iron parts is loosened gradually; the shocks caused by the traffic over a bridge are yet to be added. Iron bridges, therefore, should be carefully examined from time to time, and worn out parts replaced immediately by new ones. Finally, a fourth example may be cited. The chain of a crane in a covered room, which is not exposed to rust-creating humidity and is warranted to carry a burden of 500 pounds, may, after years of use, break suddenly while carrying only one-half of that burden. In carrying a load the links of the chain have the tendency to contract in the middle, and a certain tension is caused, by which the crystalline and apparently fibrous structure of the links is destroyed, which may easily be the cause of serious accidents, if the chain is not examined at certain intervals.

Improvement in Making Cores.

The core department is in many foundries a source of annoyance. This is not because coremakers are inferior to those of a generation ago, but has been brought about by a gradual change in the form of castings. Complicated cores are much more common now than ever before, and many foundries experience great difficulty in producing these, because they consider the old materials used in coremaking, such as flour, resin or claywash, which do very well for heavy ordinary cores, as the proper ingredients for others of a more complex character.

A desirable core material is one that permits of being easily mixed with the sand, is unaffected by heat or cold, retains its binding qualities indefinitely, contains the minimum of gas-producing elements, permits the ready escape of vent by leaving the core porous, and last, but not least, allows the foundry to be occupied at casting time, without suffocating its inmates with the blinding and disagreeable odors such as every foundryman has experienced.

The National Jelloluse Co., of 547 West 43d street, New York City, have placed on the market a core compound called Jelloluse which they claim meets the above mentioned qualifications. They add, that black or gangway sand may with this compound be utilized, and that the cores made of this material will disintegrate as well as if made from new sand.

It is said to furnish a very economical core mixture, and any responsible founder who desires to test it can obtain a free sample by addressing the manufacturers.

Edward Smith & Company, of 45 Broadway, New York City, have issued a third edition of the work, "Application of Paints, Varnishes and Enamels for the protection of iron and steel structures and hydraulic work." The title of the book indicates its contents, which has been enlarged over former editions. With the increased use of metal in exposed places the necessity for some medium to prolong its life is felt, and those interested therein would do well in perusing the contents of this additional literature upon the subject.

Imperial Hot Blast Torch.

The tool illustrated herewith has been specially designed to meet the requirements of foundries, where it is often desired to skin-dry small molds or parts of larger ones. It will be found of the greatest utility in drying out corners and pockets, where the swab may have deposited too much water. Out-

side of hard ramming water is the greatest producer of imperfections, since the iron refuses to lay against sand containing too much of this element. The simplicity and low cost of this torch places it within the reach of all. It is handled by the S. Obermayer Co., Cincinnati, Ohio.

"Modern Methods" is an illustrated pamphlet issued by the Link Belt Machinery Co., of Chicago, describing their latest coal and freight handling machinery. A leaflet accompanying shows examples of machine molded sheave wheels, which is claimed to be not only cheaper but far superior to wheels having turned grooves.

A new pig iron tonnage record has been made by the Carnegie Steel Co.'s new furnace, No. 1, located at Duquesne, Pa. In 30 days it produced 17,195 gross tons, an average of 574 tons per day. Two of the Duquesne furnaces are now in operation, and two others are in an advanced stage of construction.

L. W. Boutelle, of Orange, Mass., is increasing his facilities for turning out Snap Flasks suited to the different requirements of the foundry.

No progressive molder should be without it. LOUIS LULVISEN,
Chillicothe, O.

NOTICE!

Advertisements in this column, 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.

Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

WANTED—Experienced foundry foreman. One who understands making of hollow ware and other castings. Address Box 25, care THE FOUNDRY.

FOR SALE—No. 3 Root blower, used only a few months; to be replaced with largest size. Address Box 4, care THE FOUNDRY PUBLISHING CO.

SITUATION WANTED—By a thoroughly competent man, both as a mechanic and manager, to assume charge of foundry plant, proficient in economical production. Has experience. Can furnish reference. Address Box 58, care THE FOUNDRY.

A JOBBING FOUNDRY situated in one of the large eastern cities; established about ten years; would like a good practical molder as foreman and one who can take an interest in the business; about $2,500.00 required; a good opportunity for the right party. Address, Box 73, care THE FOUNDRY.

FOR SALE—A well equipped machine shop and foundry, situated in a prominent railroad center in the State of New York; the only jobbing machine shop and foundry in the city, and doing a good business; good and sufficient reasons given for wishing to dispose of the business. Address, Box 72, care THE FOUNDRY.

LIVE FOUNDRYMEN, ATTENTION!—I want to make a change if I can find the right party. Competent to fill any position in foundry life and have the experience; you needn't pay for experiments. Best reference. Life is too short to waste, hence only those really wanting a man of energy to conduct their business, please address Box 27, care THE FOUNDRY.

WANTED—Situation as foundry foreman by one who has had ten years' experience as foreman on all classes of work. Thoroughly capable of handling a foundry in all its details. Can manage men to the best advantage and understands the melting and mixing of iron to obtain different qualities. Can give the best of references as to character and ability. Address Box 53, THE FOUNDRY.

FOR SALE—A complete set of iron patterns for one of the most modern constructed corrugated warm air furnaces on the market, including three sizes. Also a first-class set of register patterns. Furnace has been on the market five years and has good established trade, which goes with patterns. Price reasonable. Reasons for selling, other business demands our capital and attention. Address Box 48, THE FOUNDRY.

Foundry Roof for Sale.

Width of building 155 feet out to out, divided into a center span of 66 feet, with a wing on each side 46 feet 6 inches in width. Total length of building 350 feet. This roof was designed for an iron foundry, but owing to the failure of the purchaser, is now offered for sale at a bargain. The side walls and gables of the building are of brick, the roof trusses and columns only, being for sale. There is also with the foundry a cupola 57 inches in diameter, 80 feet high, made of ⅜ inch boiler iron complete with a No. 8 Sturtevant Blower. Manufacturers contemplating a new foundry will find it to their advantage to look into this, as the building is nearly new and we will sell at a bargain.

Write to THE BERLIN IRON BRIDGE CO., East Berlin, Conn.

Among recent shipments of Whiting Cupolas manufactured by Whiting Foundry Equipment Co. of Harvey and Chicago, are the following: To Dobbie Foundry and Machine Co., Niagara Falls, N. Y., 1 10-ton per hour Cupola; to Hoffman & Billings Co., Milwaukee, 1 12-ton per hour Cupola; to Wells & French Co., Chicago, 1 5-ton and 1 1-ton per hour Cupola.